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Overview of progress towards sustainable development: a review of the implementation of Agenda 21, the Programme for the Further Implementation of Agenda 21 and the Johannesburg Plan of Implementation

Report of the Secretary-General

Summary

The present report has been prepared at a critical moment. In 2008, the global economy was affected by a succession of crises, the effects of which still threaten to reverse progress on all key dimensions of sustainable development. As a result, the progress being made on attaining the goals of Agenda 21, the Johannesburg Plan of Implementation and the Millennium Summit has been placed in jeopardy. After a steadily declining trend, poverty rates are beginning to inch up again, the incidence of hunger and malnutrition are increasing and the hope of achieving the Millennium Development Goals is being threatened. On the other hand, the succession of crises has led to an enhanced political commitment to achieving these goals. The focus herein is on important recent developments, new data and the progress made in understanding "what works".

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I. Introduction

1. The present report provides a brief review of the progress made in the implementation of Agenda 21,[1] the Programme for the Further Implementation of Agenda 21[2] and the Plan of Implementation of the World Summit on Sustainable Development ("Johannesburg Plan of Implementation").[3] Not considered here or not elaborated extensively are topics covered in separate reports submitted to the Commission on Sustainable Development at its eighteenth session: that is, on transport, chemicals, waste management, mining and the 10-year Framework of Programmes for Sustainable Consumption and Production Patterns under the Marrakech Process. The focus herein is on important recent developments, new data and progress in understanding "what works".

II. Overview

2. Depending on how sustainable development, with its three pillars, is approached, global development can unfold along dramatically different pathways. It has been two decades since the concept of "sustainable development" entered the lexicon of the international community, inspiring countless international meetings and even some action. However, the first wave of sustainability activity, in progress since the Earth Summit[4] of 1992, has been insufficient to reverse alarming global trends in resource depletion and environmental degradation. In a finite planet, the continued growth in the use of materials or throughput will eventually lead to ecological disaster. A shift to more resource-efficient and sustainable patterns of consumption and production is therefore required. However, continued economic growth is absolutely essential, at least until the large differences between developed and developing countries — in income, quality of life, human development indicators and levels of poverty and deprivation — are bridged. In the first instance, the concept proposes that the unfinished development agenda be completed apace, but in a manner that minimizes the pressure on natural resources and starts laying the foundation of the transition to a sustainable society.

3. Going beyond this level, however, the concept also seeks to show that the development agenda and the sustainability agenda are not in conflict. In fact, the more speedily the unfinished agenda of development and poverty eradication is completed, the more quickly can there be a transformation towards a sustainable society.

4. A new wave must produce a new sustainability paradigm which would challenge both the viability and desirability of conventional values, economic structures and social arrangements. It would offer a positive vision of a civilized

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[1] *Report of the United Nations Conference on Environment and Development, Rio de Janeiro, 3-14 June 1992*, vol. I, *Resolutions Adopted by the Conference* (United Nations publication, Sales No. E.93.I.8 and corrigendum), resolution 1, annex II.

[2] General Assembly resolution S-19/2, annex.

[3] *Report of the World Summit on Sustainable Development, Johannesburg, South Africa, 26 August-4 September 2002* (United Nations publication, Sales No. E.03.II.A.1 and corrigendum), chap. I, resolution 2, annex.

[4] *Report of the United Nations Conference on Environment and Development, Rio de Janeiro, 3-14 June 1992*, vol. I, *Resolutions Adopted by the Conference* (United Nations publication, Sales No. E.93.I.8 and corrigendum), resolution 1, annex II.

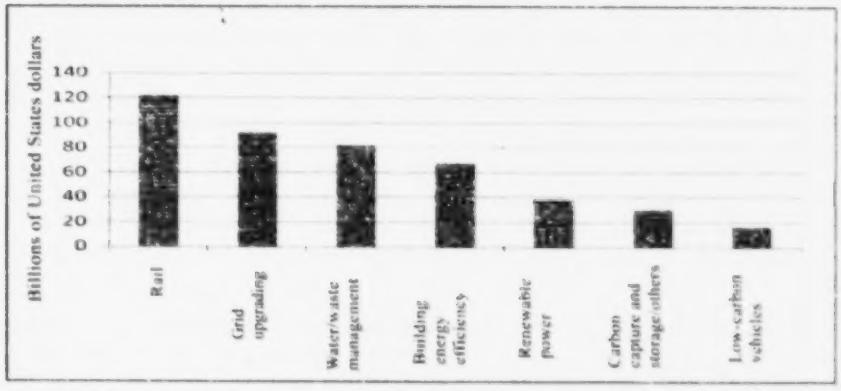
form of globalization for the entire human family. However, this will happen only if key sectors of global society come to understand the nature and the gravity of the challenge, and seize the opportunity to revise their agendas.[5]

5. These current economic and environmental difficulties offer an opportunity for global collective rethinking of the development and business models that had been used over the last century, and for a shift to a new model that would help to put the world on a climate-friendly and sustainable economic path. One innovative response is the "green economy", which would entail a transition towards an economic system dominated by the production, exchange, distribution and consumption of environmentally friendly goods and services.

6. Through a green-growth process, such a transition could offer a way forward out of the current crisis, as well as a means of promoting competitiveness in the industries of the future through the creation of so-called green jobs, the preservation of the Earth's natural capital, the alleviation of poverty and thus the enabling of green growth at the global level. A green economy is one that includes green investment as a central pillar of both government budgets and public-private funding mechanisms. Several countries are already prioritizing green investment and developing strategies and policies to support a green economy, while researchers are developing the conceptual and empirical support for such policies.

7. In the aftermath of the recent financial and economic crisis, many Governments around the world have announced massive fiscal stimulus packages of over $3 trillion (see figures I and II).

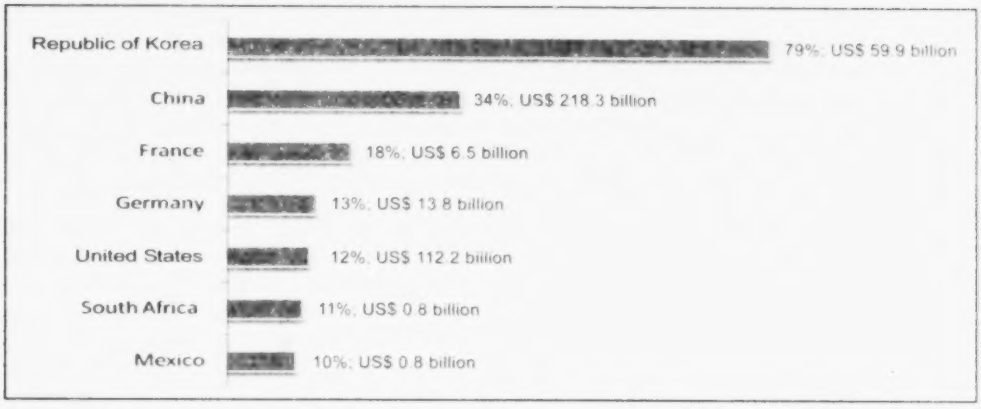
Figure I
Group of Twenty green stimulus spending per sector



Source: HSBC Global Research and the United Nations Environment Programme.

[5] See Paul Raskin, Tariq Banuri, Gilberto Gallopin, Pablo Gutman, Al Hammond, Robert Kates and Rob Swart, *Great Transition: The Promise and Lure of the Times Ahead*, Stockholm Environment Institute, Boston, United States of America, 2002.

Figure II
Green stimulus ranking as a percentage of total stimulus, as of August 2009



Source: HSBC Global Research and the United Nations Environment Programme.

8. About 15 per cent of the announced total economic stimulus packages have been allocated to green fiscal and investment measures to support renewable energy, energy efficiency in buildings, grid upgrading, water and waste management and railway networks.

9. An investment of 1 per cent of global GDP over the next 2 years could provide the critical mass of green infrastructure needed to seed a significant greening of the global economy (of course, the specific focus of the investment would differ between developed and developing countries, as would the mix of fiscal and aid funding). The overall size of this recommended "green" stimulus is well within the realm of the possible: at 1 per cent of global GDP, that is, approximately $750 billion, the amount is only one fourth of the total size of proposed fiscal stimulus packages.[6]

10. As a response to the financial and economic crisis, these commitments represent the first steps towards a "global green new deal", which has three broad objectives: to make a major contribution to reviving the global economy, saving and creating jobs and protecting vulnerable groups; to promote sustainable and inclusive growth and the achievement of the Millennium Development Goals, especially ending extreme poverty by 2015; and to reduce carbon dependency and ecosystem degradation. These are key risks along a path to a sustainable global economy.[7]

11. Beyond recovery, efforts are needed to initiate and sustain a long-term process of greening the global economy, by reconfiguring businesses and infrastructure to deliver better returns on natural, human and economic capital investments, while at the same time reducing greenhouse gas emissions, extracting and using fewer natural resources, creating less pollution and waste and reducing social disparities, while remaining within the carrying capacity of ecosystems. At the same time, significant structural changes are necessary in the international and domestic policy architecture. Together, this set of actions could provide the foundations for the emergence of a future green economy. In this regard, the UNEP-led Green Economy

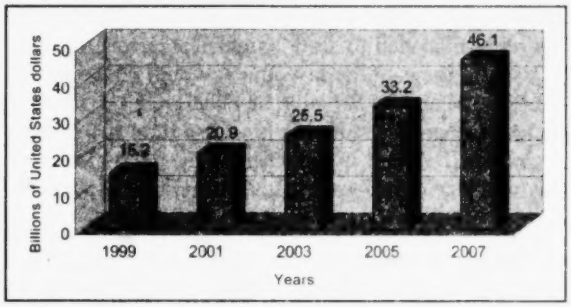
[6] Edward B. Barbier, "A global green new deal", paper proposed for the UNEP Division of Technology, Industry and Economics, February 2009.

[7] See *Global Green New Deal: Policy Brief*, UNEP, March 2009.

Initiative assists Governments in shaping and focusing policies, investments and spending towards a range of green sectors, such as clean technology, industry, renewable forms of energy, water services, transport, waste management, green buildings, and sustainable agriculture and forests. The initiative involves a number of UNEP and United Nations-wide initiatives that are aimed at providing convincing macroeconomic evidence for significantly increasing investments in the environment as a means of promoting sustainable economic growth, the creation of decent jobs and the reduction of poverty, while at the same time reducing greenhouse gas emissions, extracting and using less natural resources and creating less waste.

12. Forging a green economy is closely interlinked with efforts to promote sustainable consumption and production. Stimulating investments in sustainable production increases net welfare gains from economic activities by "doing more and better, with less". Sustainable production practices reduce resource use and depletion and result in less pollution. Likewise, spurring demand for more sustainable products through the promotion of sustainable consumption could create new markets for businesses adopting sustainable production practices, resulting in increased revenue streams and new jobs. For instance, major markets for organic food and beverages are expanding on average by 10-20 per cent per year and global trade in these products now stands at $50 billion annually.

Figure III
Global market for organic food and drinks



Source: Research Institute of Organic Agriculture and International Federation of Organic Agriculture Movements. *The World of Organic Agriculture: Statistics and Emerging Trends 2010*, Bonn, Germany, FiBL and IFOAM, 2010.

III. Poverty eradication and human development

13. Human development is the process of enlarging people's choices. At all levels of development, the three essential choices are for people to lead a long and healthy life, to acquire knowledge and to have access to the resources needed for a decent standard of living. If these essential choices are not available, many other opportunities remain inaccessible. Development must be more than just the expansion of income and wealth. The focus of development must be people.[8] Therefore, the subsequent paragraphs in this section should be taken in this context.

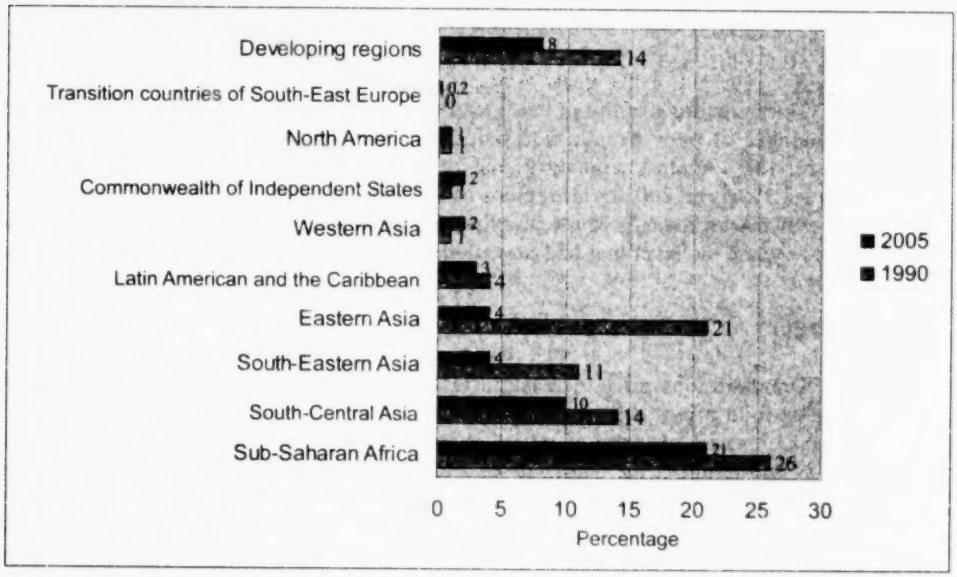
[8] United Nations Development Programme, *Human Development Report 1990*, New York, UNDP and Oxford University Press, 1990.

A. Poverty eradication

14. Poverty eradication has had mixed results. Prior to the recent global crisis and higher food prices, the number of people in developing regions of the world living in extreme poverty, that is, on less than US$ 1.25 a day, fell from 1.8 billion in 1990 to 1.4 billion in 2005. As a result, those people considered as extremely poor accounted for slightly more than a quarter of the developing world's population in 2005, compared with almost half that population in 1990. There was a dramatic drop in the poverty rate in Eastern Asia, thanks in large part to rapid economic growth in China, which helped to lift 475 million people out of extreme poverty. Sub-Saharan Africa counted 100 million more extremely poor people in 2005 than in 1990, and the poverty rate remained above 50 per cent (although it had begun to decline after 1999).[9]

15. Deep inequalities across the world persist. The 40 per cent of the world's population living on less than US$ 2 a day account for 5 percent of global income, while rural areas account for three out of every four people living on less than $1 a day. The richest 20 per cent account for three quarters of global income. In the case of sub-Saharan Africa, a whole region has been left behind: it will account for almost one third of global poverty in 2015, up from one fifth in 1990[10] (see figures IV and V).

Figure IV
Poverty gap percentage ratio at US$ 1.25 a day, 1990 and 2005

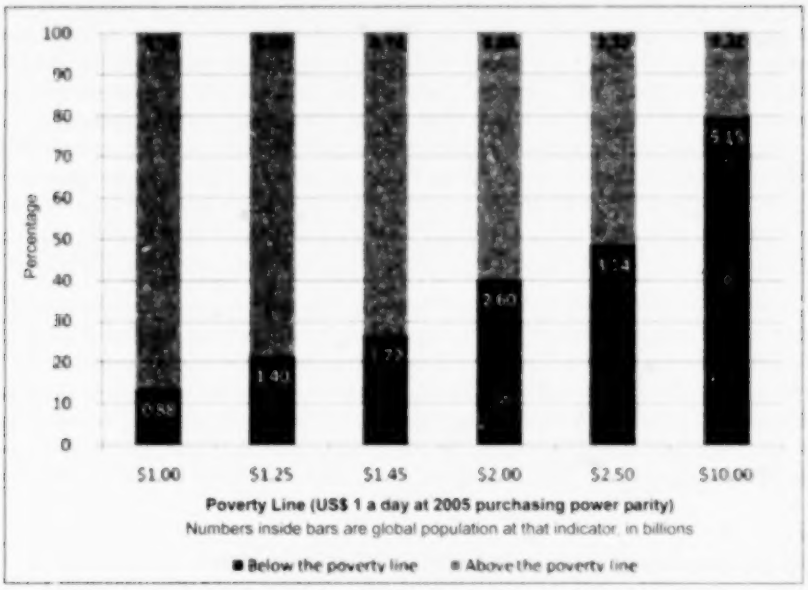


Source: *Millennium Development Goals Report 2009*.

[9] United Nations, *The Millennium Development Goals Report 2009* (United Nations publication, Sales No. E.09.I.1).

[10] United Nations Development Programme, *Human Development Report 2007/2008: Fighting Climate Change: Human Solidarity in a Divided World*, New York, UNDP, 2007.

Figure V
Percentage of people in the world at different poverty levels, 2005



Source: World Bank, *World Bank Development Indicators 2008*, Washington, D.C., World Bank, 2008.

16. The magnitude of the poverty eradication challenge is determined not only by the number of poor people worldwide, but also by how far they fall below the poverty line. Against a poverty line of $1.25 a day, the poverty gap narrowed between 1990 and 2005 in all regions of the world except Western Asia. In 2005, the depth of poverty was greatest in sub-Saharan Africa, but has dropped lower since 1999 to reach the level that had prevailed in Eastern Asia in 1990.

B. Hunger

17. Dramatic food price increases affected much of the developing world in 2008. Even as food prices had begun to relax in 2009, this trend remains highly uneven across countries; in many countries local food prices are still high relative to past levels. Furthermore, the challenge of addressing the root causes of the global food crisis persists. Some factors behind the global food crisis that erupted in 2008 are immediate and possibly short-term in nature, such as the volatility in the commodities markets arising from short-term financial speculation. Others, however, are going to, or have already started to, affect countries' food security in the medium to longer term. These include (a) rising and changing patterns of consumption in fast-growing and large developing countries such as China and India; (b) the possibly increasing trade-off between biofuels and food; and (c) the unfolding effects of climate change.

18. In the short term, the vast majority of poor urban and rural households are being hit hardest by higher prices. Among the poor, it is the landless and female-

headed households that are most vulnerable to sharp rises in basic food prices.[11] Rapidly rising food prices caused the proportion of people going hungry in sub-Saharan Africa and Oceania to increase in 2008. When China is excluded, the prevalence of hunger also rose in Eastern Asia (see box 1).[12] In most of the other regions, the effect was to arrest the downward trend.[9]

Box 1

Philippines: price of rice increases poverty

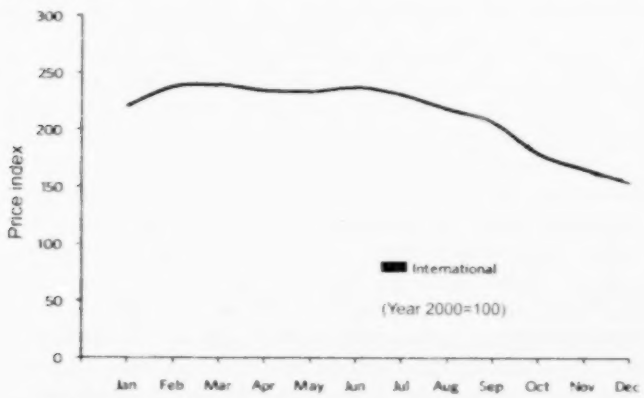
Soaring rice prices are pushing more families in the Philippines into poverty, making it more difficult for the country to achieve Millennium Development Goal 1 (halving the proportion of people living on less than US$ 1 per day by 2015). More than 24 per cent of Philippine families were living in extreme poverty in 1991. While that rate had declined to 13.5 per cent in 2003, it has started rising again. Inflation rose by nearly 2 percentage points to 8.3 per cent from March to April 2008 and reached 9.6 per cent in May, the highest level since 1999.

Source: IRIN news service May/June 2008, *The State of Food Insecurity in the World 2008: High Food Prices and Food Insecurity — Threats and Opportunities*, Rome, FAO, 2008.

19. Although prices have declined, the global economic recession is pushing households back into poverty and therefore sustaining food insecurity, since a decrease in international food prices has failed to translate into more affordable food at local markets (see figure VI).

Figure VI

International food price index and consumer food price index in selected countries, 2008



Source: *Millennium Development Goals Report 2009*.

[11] Food and Agriculture Organization of the United Nations, *The State of Food Insecurity in the World 2008: High Food Prices and Food Insecurity — Threats and Opportunities*, Rome, FAO, 2008.

[12] See UNDP, *Human Development Report 2007/2008*.

20. The response to the food security crisis, therefore, needs to address the immediate dimension of ameliorating the condition of households and populations facing hunger and undernutrition and the longer-term need to build resilience and overcome structural conditions that perpetuate food insecurity. At the international level, the 2008 food crisis galvanized the global policy community into action, and they began to mobilize political and financial support for taking ameliorative and constructive measures.

21. At the national level, the food security agenda needs to be incorporated into national sustainable development strategies. Governments need to implement measures to increase the availability of food, including raising production, and to strengthen social policies that address the negative effects of higher food prices, especially as they affect the poor.

C. Health

22. Health and development are interconnected. Insufficient development, leading to poverty and inappropriate development resulting in overconsumption, coupled with an expanding global population, together can result in severe health problems in both developing and developed countries. The linkage between health, environmental and socio-economic improvements requires intersectoral efforts.

23. Countries ought to develop plans for priority actions which are based on cooperative planning by the various levels of Government, non-governmental organizations and local communities. They should develop plans that are fully integrated into national and local sustainable development plans in order to achieve the Millennium Development Goals related to reducing child and maternal mortality and combating HIV/AIDS, malaria, tuberculosis and other diseases. However, progress in this regard could be reversed as a result of the current financial crisis (see box 2).

Box 2
Côte d'Ivoire: high prices cut health spending

In Côte d'Ivoire, poor urban people are seeking to cut down on the purchase of essential items, such as medicine. An example is the case of Drissa Kone, a man with a severe respiratory infection and a prescription for medicines that would cost CFA francs 35,000 (US$ 83) at official prices. Drissa Kone has no hope of raising enough money to buy the medicines. His solution is to buy counterfeit medicines at Abidjan's Adjame market, where he can find an illegal reproduction of the original drug at a fraction of the price. He said: "I can buy the same medicines at the market by the individual tablet not the packet, and pay just CFA francs 150 [US$ 0.35] per pill. For CFA francs 500 (US$ 1.19), I can get enough medicine to last me three days!" The downside, however, concerns the quality of the medicines, as they are usually less effective than the authentic originals — a serious problem when treating potentially deadly illnesses such as malaria. Imitation medicines sometimes contain a chemical mix that further harms people's health.

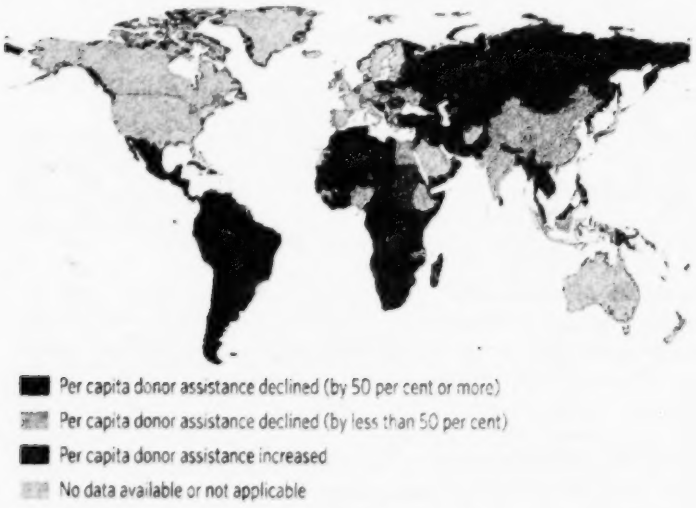
Source: IRIN news service, July 2008 and Food and Agriculture Organization of the United Nations, *The State of Food Insecurity in the World 2008: High Food Prices and Food Insecurity — Threats and Opportunities*, Rome, FAO, 2008.

24. Death in children under five years of age has declined steadily worldwide. In 2007, the global under-five mortality rate was 67 deaths per 1,000 live births, down from 93 in 1990. For the developing regions as a whole, the under-five mortality rate dropped from 103 death per 1,000 in 1990 to 74 in 2007. Still, many countries, particularly in sub-Saharan Africa (where 1 in 7 children dies before his or her fifth birthday) and South Central Asia, have made little or no progress at all.

25. Every year, 536,000 women and girls die as a result of complications during pregnancy, childbirth or the six-week period following delivery, with 99 per cent of such deaths occurring in developing countries (450 maternal deaths per 100,000 live births). Maternal deaths in sub-Saharan Africa (265,000) and in Southern Asia (187,000) together account for 85 per cent of all maternal deaths.[13] Yet, donor funding for family planning is declining: since the mid-1990s, most developing countries have experienced a major reduction in donor funding (see figure VII).

Figure VII

Percentage change in donor assistance for family planning programmes per woman aged 15-49, 1996-2006


Per capita donor assistance declined (by 50 per cent or more)
Per capita donor assistance declined (by less than 50 per cent)
Per capita donor assistance increased
No data available or not applicable

Source: Millennium Development Goals Report 2009.

26. Worldwide, the number of people newly infected with HIV peaked in 1996; the number has since declined to 2.7 million in 2007. These positive trends are due mostly to a decline in the annual number of new infections in some countries in Asia, Latin America and sub-Saharan Africa. Meanwhile, infection rates continue to rise in other parts of the world, especially in Eastern Europe and Central Asia. The estimated number of AIDS deaths also appears to have peaked, at 2.2 million in 2005, and has since declined to 2 million in 2007. This is partly due to increased access to antiretroviral drugs in poorer countries. Despite an overall decrease in the

[13] IRIN news service, July 2008 and Food and Agriculture Organization of the United Nations, *The State of Food Insecurity in the World 2008: High Food Prices and Food Insecurity — Threats and Opportunities*, Rome, FAO, 2008.

number of new infections, in 2007 an estimated 33 million people were living with HIV, many of whom are children (see box 3).[9]

Box 3
The plight of children affected by AIDS

In 2007, an estimated 15 million children worldwide had lost one or both parents to AIDS; nearly 12 million of them live in sub-Saharan Africa. Responses to the plight of such children at the national level have been growing since the 1990s. By the end of 2007, national plans of action specifically for children orphaned by AIDS and other vulnerable children had been developed in 32 countries, including 29 in sub-Saharan Africa. In addition, 10 more countries — 9 in sub-Saharan Africa — were in the process of drawing up such plans. Many countries are integrating into their national development plans policies for children affected by AIDS. Since many AIDS-affected children cluster in poor households with low levels of education, helping all vulnerable children is a wise and cost-effective strategy for reaching children affected by HIV and AIDS.

Source: *Millennium Development Goals Report 2009*.

27. Major progress has been made in the fight against malaria in recent years, due in large part to increased funding and focus on malaria control, even though according to the World Health Organization (WHO), nearly a million people died of malaria in 2006; 95 per cent of them had lived in sub-Saharan Africa, and the vast majority comprised children under five years of age.[9]

28. The global incidence of tuberculosis, that is, the number of new cases per 100,000 persons, appears to have peaked in 2004 and is now levelling off, but the absolute number of new infections is still rising. Globally, there were an estimated 9.3 million new cases of tuberculosis in 2007, up from 9.2 million cases in 2006 and 8.3 million in 2000. Most of the cases in 2007 occurred in Asia (55 per cent) and Africa (31 per cent). Improvements in laboratory testing of cultures and drug-susceptibility testing are urgently needed, as well as in the diagnosis and treatment of multidrug-resistant tuberculosis and the implementation of joint tuberculosis-HIV initiatives are also very important.[9]

D. Education

29. The world is edging closer to the attainment of universal primary education, but too slowly to meet the 2015 target. Major breakthroughs have been achieved in sub-Saharan Africa, where enrolment increased by 15 percentage points between 2000 and 2007, and Southern Asia, which gained 11 percentage points over the same period. In many countries, improvements in school enrolment have been associated with increases in national spending on education, which could be dealt a serious blow as a result of the ongoing global financial and economic crisis. However, still a large number of children, mostly girls, are denied the right to education (see box 4).

Box 4
Worldwide 72 million children are denied the right to education

The number of children of primary school age who are out of school has dropped by 33 million since 1999. Yet, the number not in school remains large. Almost half of the 72 million children worldwide who were denied the right to an education in 2007 live in sub-Saharan Africa, followed by South-Central Asia, home to 18 million out-of-school children. About 30 per cent of children out of school in the developing world may eventually enrol as late entrants. A further 23 per cent were previously enrolled but dropped out. The problem is magnified in sub-Saharan Africa. Not only does that region have the largest number of children out of school, but two thirds of them will probably never enrol. The same situation exists in Western Asia, where 64 per cent of the 3 million children out of school are girls. Two thirds of the millions of children out of school in South-Central Asia were enrolled at one time, but subsequently dropped out.

Source: *Millennium Development Goals Report 2009*.

30. Education for sustainable development is another way to improve the quality of basic education, reorient educational programmes, develop public understanding and awareness and provide training. This concept supports five fundamental types of learning in order to provide good-quality education and foster sustainable human development: learning to know, learning to be, learning to live together, learning to do and learning to transform oneself and society. The Decade of Education for Sustainable Development, adopted in 2002 by the United Nations General Assembly for the period from 2005 to 2014, is aimed at promoting sustainable skills and behaviour, inspired by creative and critical ways of thinking, in order to encourage the resolution and management of problems that stand in the way of sustainable development.

IV. Promoting sustainable agriculture and rural development

31. In the twenty-first century, agriculture continues to be a fundamental instrument for sustainable development and poverty reduction; thus, promoting agriculture is imperative for meeting the Millennium Development Goal of halving poverty and hunger by 2015 and continuing to reduce poverty and hunger for several decades thereafter.[14] Cross-country evidence shows the effect of agricultural growth on poverty reduction (see box 5).

[14] World Bank, *World Development Report 2008: Agriculture for Development*, Washington, D.C., World Bank, 2007.

Box 5

Cross-country evidence of the effect of agricultural growth on poverty reduction

Among 42 developing countries over the period 1981-2003, 1 per cent of GDP growth originating in agriculture increased the expenditures of the 3 poorest deciles by at least 2.5 times as much as growth originating in the rest of the economy. Similarly, an increase in overall GDP coming from agricultural labour productivity is on average 2.9 times more effective in raising the incomes of the poorest quintile in developing countries and 2.5 times more effective for countries in Latin America than an equivalent increase in GDP coming from non-agricultural labour productivity. In focusing on absolute poverty instead and based on observations from 80 countries during the period 1980-2001, it has been shown that the comparative advantage of agriculture declined from being 2.7 times more effective in reducing the incidence of $1-a-day poverty in the poorest quarter of countries in the sample to 2 times more effective in the richest quarter of the countries. By using cross-country regressions per region and looking at $2-a-day poverty, larger effects from agricultural growth on poverty reduction in sub-Saharan Africa and South Asia have been reported, along with larger poverty-reducing effects of growth originating in other sectors in East Asia and in Latin America.

Source: World Bank, *World Development Report 2008: Agriculture for development*, Washington, D.C., World Bank, 2007.

32. Agriculture contributes to development in several ways. As an economic activity, agriculture can be a source of growth for the national economy, a provider of investment opportunities for the private sector and a prime driver of agriculture-related industries and the rural non-farm economy. Two thirds of the world's agricultural value added is created in developing countries. In agriculture-based countries, it generates on average 29 per cent of GDP and employs 65 per cent of the labour force.[14]

33. Agriculture is a source of livelihood for an estimated 86 per cent of rural people. It provides jobs for 1.3 billion smallholders and landless workers; this is because, of the developing world's 5.5 billion people, 3 billion live in rural areas. Of these rural inhabitants an estimated 2.5 billion are living in households involved in agriculture and 1.5 billion are in smallholder households.[14]

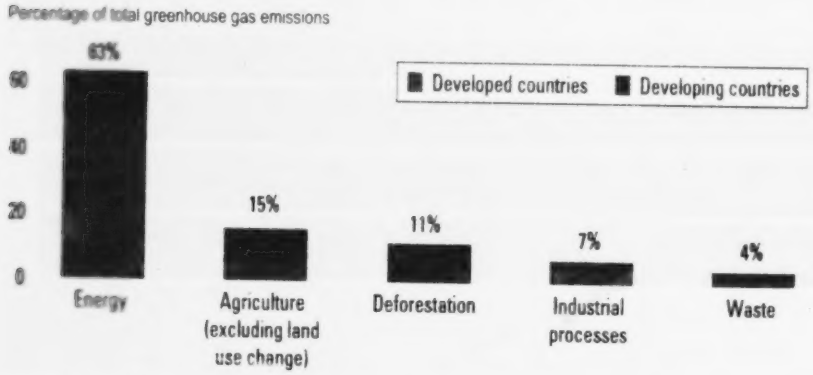
34. As a provider of environmental services, agriculture can create both good and bad environmental outcomes. It is by far the largest user of water, contributing to water scarcity, and it plays a role in agrochemical pollution, soil exhaustion and global climate change, accounting for up to 30 per cent of greenhouse gas emissions. However, it is also a major provider of environmental services, sequestering carbon, managing watersheds and preserving biodiversity. Making the farming systems of the rural poor less vulnerable to climate change is imperative.

Managing the connections among agriculture, natural resource conservation and the environment must be an integral part of using agriculture for development.[15]

35. Agriculture is also dependent on climate and is sensitive to climate change. The majority (about 80 per cent) of total emissions from agriculture, including deforestation, are from developing countries. The inventories of emissions that Governments submit to the United Nations Framework Convention on Climate Change[16] show that agriculture and deforestation account for 11 to 15 per cent of greenhouse gas emissions (see figure VIII). On the other hand, agriculture and forestry can play a key role in tackling climate change.

Figure VIII

Agriculture and associated deforestation activities as major sources of greenhouse gas emissions



Source: World Bank, *World Development Report 2008: Agriculture for Development*, Washington, D.C., World Bank, 2007.

36. In developing countries, climate change will cause declines in the yields of the most important crops, such as rice, wheat, maize and soybeans, which will result in price increases (see figure IX). South-Central Asia will be particularly adversely affected. Thus, aggressive agricultural productivity investments of $7.1-7.3 billion are needed to raise calorie consumption enough to offset the negative impacts of climate change on people's health and well-being.[17]

[15] International Fund for Agricultural Development, "Climate change: a development change" (www.ifad.org/climate).

[16] United Nations, *Treaty Series*, vol. 1771, No. 30822.

[17] International Food Policy Research Institute (IFPRI), *Climate Change: Impact on Agriculture and Costs of Adaptation*, Washington, D.C., IFPRI, 2009.

Figure IX

Yield change between 2000 and 2050, by crop and management system: the Commonwealth Scientific and Research Organization and the National Centre for Atmospheric Research scenarios, with and without carbon dioxide fertilization

	No carbon dioxide fertilization		*With carbon dioxide fertilization*	
Region	*Commonwealth Scientific and Research Organization*	*National Centre for Atmospheric Research*	*Commonwealth Scientific and Research Organization*	*National Centre for Atmospheric Research*
Maize (irrigated)				
Developing countries	-2.0	-2.8	2.4	-2.1
Developed countries	-1.2	-8.7	10.5	-8.6
Maize (rainfed)				
Developing countries	1.4	-2.0	6.6	-0.4
Developed countries	0.6	-5.7	23.9	2.5
Rice (irrigated)				
Developing countries	-14.4	-18.5	2.4	-0.5
Developed countries	-3.5	-5.5	10.5	9.0
Rice (rainfed)				
Developing countries	-0.9	-0.8	6.6	6.6
Developed countries	17.7	10.8	23.9	18.3
Wheat (irrigated)				
Developing countries	-28.3	-34.3	-20.8	-27.2
Developed countries	-5.7	-4.9	-1.3	0.0
Wheat (rainfed)				
Developing countries	-1.4	-1.1	9.4	8.6
Developed countries	3.1	2.4	9.7	9.5

Source: International Food Policy Research Institute (IFPRI), *Climate Change: Impact on Agriculture and Costs of Adaptation*, Washington, D.C., IFPRI, 2009.

A. Water for sustainable agriculture, land conservation and rehabilitation, integrated land use planning and land management practices and impact on climate change

37. Agriculture is the major user of freshwater, accounting for almost 70 per cent of water withdrawal globally.[18] However, a growing problem is the increasing competition for freshwater between agriculture, urban and industrial uses (see figure X), causing tension between rural and urban areas and possibly threatening regional or national food security, a situation which is exacerbated by climate change (see box 6).

[18] Saroja Raman, *Agricultural Sustainability: Principles, Processes and Prospects*, New York, The Haworth Press, 2006, p. 156.

Box 6

Impact of climate change on water

Himalayan snow and ice, which provides vast amounts of water for agriculture in Asia, is expected to decline by 20 per cent by 2030 owing to the effects of climate change. China is facing severe water shortages in the northern part of the country while the southern part still has abundant water resources. By 2000, two countries (Libyan Arab Jamahiriya and Saudi Arabia) had used volumes of water for irrigation which were several times larger than their annual water resources.

Source: Food and Agriculture Organization of the United Nations, "Review of global agricultural water use per country: irrigation water withdrawal" (www.fao.org/nr/water/aquastat/water_use/index.stm).

Figure X

Sector-wise water use, by continent

	Agriculture (km^3/year)		*Municipal (km^3/year)*		*Industry (km^3/year)*	
Continent	*2000*	*2025*	*2000*	*2025*	*2000*	*2025*
Africa	107	133	2.93	7.38	1.35	2.85
Asia	1 322	1 659	22.4	33.5	32.7	77.4
Europe	140	171	10.6	11	31.8	57.1
North and Central America	170	182	12.8	16.1	18.0	20.2
South America	70.8	80.9	3.7	5.6	3.4	9.9
Australia and Oceania	12.6	14.3	0.41	0.46	0.63	1.43
World	1 834	2 252	52.8	74.1	87.9	169.0

Source: Saroja Raman, *Agricultural Sustainability: Principles, Processes and Prospects*, New York, The Haworth Press, 2006.

38. The United Nations has supported the implementation of sustainable and efficient water resources development and management schemes, including integrated water resources management within each country, and, where appropriate, through international cooperation and improved irrigation efficiencies, groundwater, on-farm soil and water management practices, including for drinking water, in order to overcome water shortages, improve water quality and enhance food security.[19] Many of these are win-win measures, such as developing drought- and flood-tolerant varieties, improving climate information, or planning for hydrological variability in new irrigation investments. The United Nations has selected a series of indicators to measure progress towards each goal's achievement. The World Water Assessment Programme is contributing to the task force on water (see box 7).

[19] See E/2009/19.

Box 7

Benefits of land conservation and smallholder rehabilitation in Ghana

The Upper East Region of Ghana, which has the highest population density in the country, is synonymous with poor soils and erratic rainfall. Yet it has benefited from the International Fund for Agricultural Development's land conservation and smallholder rehabilitation project (1991-1997). The project was concerned mainly with mobilizing communities to sustain the results of rehabilitation and actually manage the use of water in the long term. The project enabled farmers to remain on and invest in the land, increasing local food security and reversing the cycle of neglect and land degradation that was occurring.

Source: IFAD press release (www.ifad.org/media/success/ghana.htm).

39. Climate change is also reducing significantly the quality of soil and the availability of water in many regions by increasing the variability of temperature and rainfall.[20] The international community needs to devise new mechanisms to provide a range of global public goods, including climate information and forecasting; research and development of crops adapted to new weather patterns; and techniques to reduce land degradation.[21]

40. Land degradation affects approximately 2 billion people living in arid zones. Without fertile soil and without tools for sustainable land management, those living in such regions are unable to break out of the cycle of poverty.[22] The International Federation of Agricultural Producers (IFAP) has stated that approximately 70 per cent of the 5.2 billion hectares of agricultural arid land in Africa is degraded.[23]

41. Dryland territories in at least 100 countries are prone to desertification, including developing countries in Africa, Asia and Latin America, as well as developed countries, such as Australia, the United States of America and Spain, and it is the poorest countries which suffer most since 8 out of 10 of the world's poorest countries are located in dryland areas.[24] Over 250 million people are directly affected by desertification, and some 1 billion are at risk. At the global level, it is estimated that the annual income foregone in the areas immediately affected by desertification amounts to approximately $42 billion each year.[25]

[20] F. N. Tubiello, J. F. Soussana and S. M. Howdan, "Climate change and food security special feature: crop and pasture response to climate change", *Proceedings of the National Academy of Science of the United States of America*, vol. 104, pp. 19686-19690.

[21] Saroja Raman, *Agricultural Sustainability: Principles, Processes and Prospects*, New York, The Haworth Press, 2006, p. 156.

[22] International Federation of Agricultural Producers, "The role of farmers in combating desertification and land degradation", AFAP Policy Statement, April 2009, p. 32.

[23] See E/CN.17/2009/10.

[24] United Nations, *Treaty Series*, vol. 1954, No. 33480.

[25] See www.unccd.int/publicinfo/factsheets/menu.php.

B. Improving farm production and farm systems

42. Improving farm production and farm systems would make agriculture more sustainable, but this would require increased efforts to include a wider audience and gain greater participation from farmers, researchers, landowners, private sector representatives, agency personnel, community members and non-profit organizations.[26]

43. It is necessary to seek more sustainable production patterns and to enhance agriculture's provision of environmental services. Many promising technological and institutional innovations can make agriculture more sustainable with minimum trade-offs on growth and poverty reduction. Water management strategies in irrigated areas must improve water productivity. Better technologies and better ways of managing modern farm inputs can also make rain-fed farming more sustainable.

44. Strengthening property rights and providing long-term incentives for natural resource management with off-farm benefits, such as matching grants for soil conservation, are necessary in both intensive and extensive farming areas. Mitigating the effects of climate change through the sustainable management of land, forests and other natural resources should be encouraged through the provision of appropriate incentives for people in rural areas.

45. Afforestation and reforestation, better land management practices, such as conservation tillage and agroforestry rehabilitation of degraded crop and pasture land and better livestock management practices, can all contribute significantly to reducing carbon emissions.

46. Many agriculture-based countries still display anaemic per capita agricultural growth (4 per cent in 2004) and little structural transformation (a declining share of agriculture in GDP and a rising share of industry and services as GDP per capita rises).[14] More investment in agriculture would help to boost the potential of rural farmers to increase their productivity, thus enhancing local and national food security and accelerating poverty reduction.

47. Making agriculture more effective in supporting sustainable growth and reducing poverty starts with a favourable socio-political climate, adequate governance and sound macroeconomic fundamentals. It requires defining an agenda for each, based on a combination of four policy objectives: improve access to markets and establish efficient value chains; enhance smallholder competitiveness and facilitate market entry; improve livelihoods in subsistence farming and low-skill rural occupations; and increase employment in agriculture and the rural non-farm economy, and enhance skills (see figure XI).

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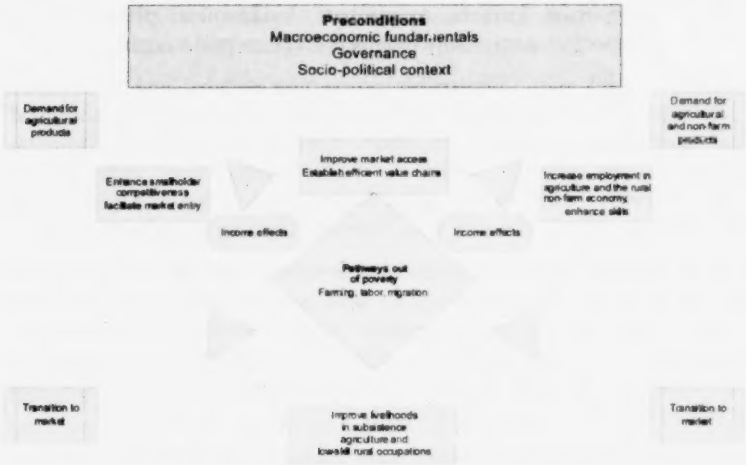
[26] G. Digiacomo, C. J. Iremonger, L. Kemp, C. Shaik and H. Murray, *Sustainable Farming Systems: Demonstrating Environmental and Economic performance*, St. Paul, MN, United States, Minnesota Institute for Sustainable Agriculture, 2001.

Figure XI

The four policy objectives of the agriculture-for-development agenda form a policy diamond



Source: World Bank, *World Development Report 2008: Agriculture for Development*.

C. Strengthening human capacity of rural people

48. The purchasing powers of rural communities do not have to come from food-based production alone. It is therefore important to decentralize non-farm economic activity by moving it into rural areas and provide assistance to help move people out of agriculture. Doing this would call for innovative policy initiatives and strong political commitment. However, it could benefit 600 million of the world's rural poor.

49. Investment in many rural forestry resources could help in creating new jobs and providing income opportunities for people in rural areas. Education is an essential prerequisite for reducing poverty, improving agriculture and the living conditions of rural people and building a food-secure world (see boxes 8 and 9).

Box 8

Education for rural people

The Food and Agriculture Organization of the United Nations (FAO) and the United Nations Educational, Scientific and Cultural Organization (UNESCO) have been encouraging member countries, international agencies and civil society to join the partnership known as Education for Rural People, which is part of the International Alliance against Hunger and of the Education for All initiative. Towards this end, FAO and UNESCO agreed to co-finance a partnership project to raise public awareness in Europe about the importance of education for rural people in poor countries. The project addresses the urgent need to target education in rural areas, where over 70 per cent of the world's poor are caught in the vicious cycle of being unable to access the services and opportunities that might take them out of poverty. FAO has engaged in educating boys and girls through school gardens and men and women through cooperatives, farmer field schools and broader extension programmes.

Source: Association for Cooperation in Rural Areas of Africa and Latin America, and Food and Agriculture Organization of the United Nations, capacity-building workshop on Education for Rural People and Food Security, Rome, 15-17 November 2004 (www.fao.org/sd/erp/ERPevents14_en.htm).

Box 9

Capacity-building of extension agents in Liberia

A United Nations/Food and Agriculture Organization of the United Nations joint programme in Liberia, established for the capacity-building of extension agents and farmers, agricultural input supply and school gardens, is an effort to strengthen rural human capacity. Thus, the initiative promotes sustainable agricultural practices among agricultural professionals that work with smallholder farmers and other rural development stakeholders. Experience from developed countries and the emerging economies in Asia has shown that victory in gaining food security can be achieved if all exert efforts to build the capacity of rural communities in skills and approaches that help to link their production in order to make and generate cash income.

Source: A. Bekele, "Capacity-building for rural people in Africa: policy agenda for improved focus on capacity-building issues, strategies and actions", paper presented at Ministerial Seminar on Education for Rural People in Africa: Policy Lessons, Options and Priorities, Addis Ababa, 7-9 September 2005.

V. Energy for sustainable development

50. Energy use is closely linked with economic development, poverty reduction and the provision of vital services. Yet, energy production, distribution and consumption can have adverse effects on the local, regional and global environment. Efforts are under way across the globe to improve access to modern energy services, increase energy efficiency, reduce air pollution and shift to cleaner energy sources. The two main challenges are securing supplies of affordable and reliable energy and effecting the rapid transformation to a low-carbon efficient and environmentally benign system of energy supply, since energy is the pivotal issue at the interface of the climate and development challenges and because the energy sector, broadly defined, accounts for 60 per cent of global emissions[27] (see table 1 A and B).

Table 1

A. Greenhouse gas emissions by sector, 2000[a]

Sector	*Megatons of carbon dioxide*	*Share (Percentage)*
Energy	24 731.2	59.4
Electricity and heat	10 296.0	24.7
Manufacturing and construction	4 426.5	10.6
Transportation	4 848.1	11.6
Other fuel combustion	3 563.3	8.6
Fugitive emissions	1 597.4	3.8
Industrial processes	1 369.4	3.3
Agriculture	5 729.3	13.8
Land-use change and forestry	7 618.6	18.3
Waste	1 360.5	3.3
International bunkers	829.4	2.0
Total	**41 638.4**	**100.0**

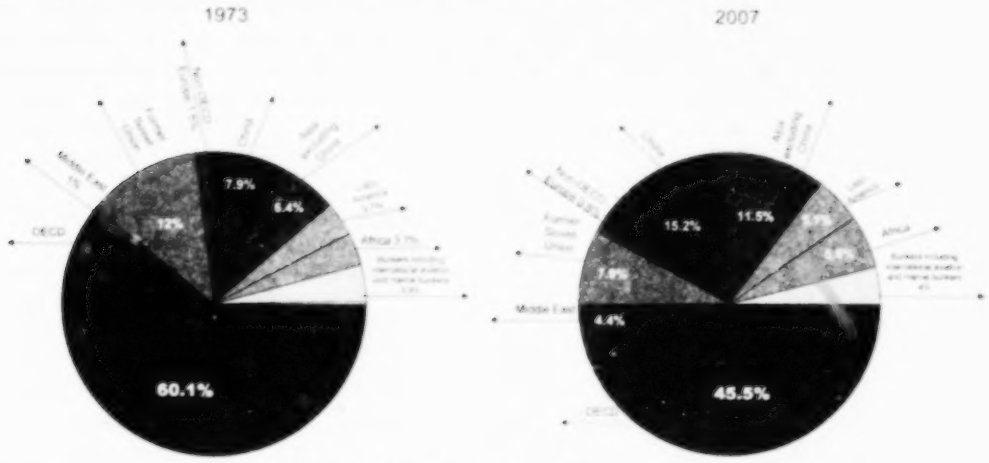
Source: Climate Analysis Indicators Tool, version 6.0, Washington, D.C., World Resources Institute, 2009, and *World Economic and Social Survey 2009: Promoting Development, Saving the Planet* (United Nations publication, Sales No. E.09.II.C.1).

Note: Data on nitrogen dioxide not available.

[a] Greenhouse gases include carbon dioxide, methane, perfluorocarbons, hydrochlorofluorocarbons and sulphur hexafluoride.

[27] United Nations, *World Economic and Social Survey 2009: Promoting Development, Saving the Planet* (United Nations publication, Sales No. E.09.II.C.1).

B. Regional shares of total final consumption: 1973 and 2007



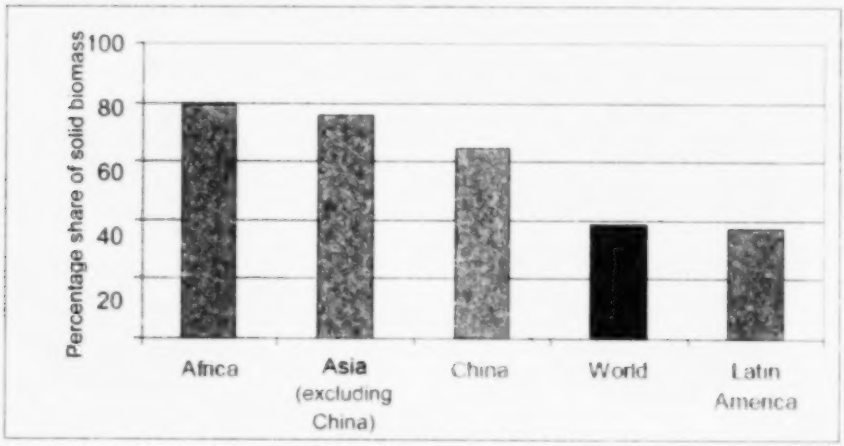
Source: International Energy Agency (IEA), Key World Energy Statistics, Paris, IEA, 2009.

A. Access to energy services

51. Access to affordable, modern energy services is a prerequisite for the achievement of sustainable development and the Millennium Development Goals and yet modern energy services are characterized by the inequitability of access, with the poor and the affluent, as well as the rural and urban areas being at the opposite ends of the scale. Indeed, about 2 billion people worldwide, one third of the world's population, are entirely without access to modern sources of energy; about 1.6 billion are without access to electricity, while 2.4 billion cook with traditional forms of biomass in the form of firewood, charcoal, manure and crop residues, which poses serious health risks, particularly as a result of indoor air pollution (see box 10). Limited access to cleaner energy services supplied by modern energy carriers is an important contributor to rising levels of poverty in some sub-Saharan African countries (see figure XII).[28]

[28] United Nations, *World Economic and Social Survey 2009: Promoting Development, Saving the Planet* (United Nations publication, Sales No. E.09.II.C.1).

Figure XII
Share of solid biomass in total residential energy consumption for major regions of the world in 2006



Source: International Energy Agency, *Energy Balances of Non-OECD Countries*, 2008 edition, Paris, OECD Publishing, 2008.

Box 10
Death due to pollution

The World Health Organization estimates that 1.5 million people die each year from the effects of indoor air pollution, a number which translates into 4,000 deaths per day. In sub-Saharan Africa alone, 396,000 deaths from indoor air pollution were reported in 2002. Additionally, most biomass is collected outside of the commercial economy, imposing immense burdens on women and sometimes children, who spend considerable time collecting such material — time which therefore cannot be spent on education and employment activities.

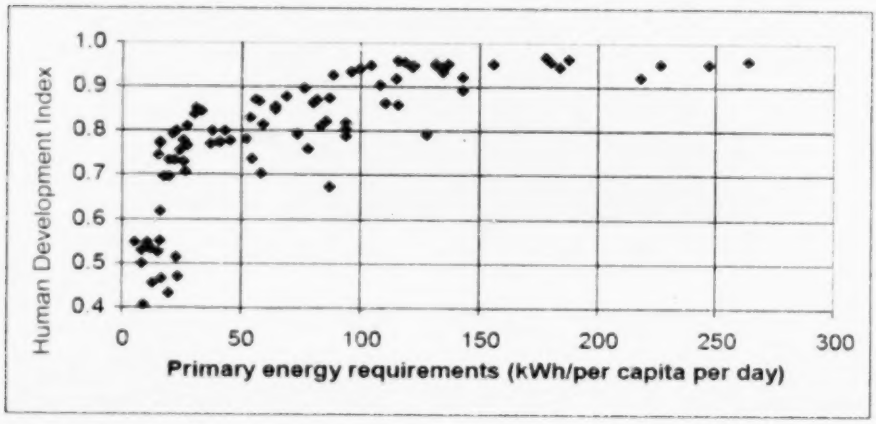
Source: World Health Organization, *Fuel for Life: Household Energy and Health*, Geneva, WHO Press, 2006.

52. The experience of many countries during the past several decades shows that higher levels of development are linked to sufficiently high levels of energy consumption (see figure XIII). That relationship is demonstrated by the fact that most of the countries with a high level of development, as measured by a human development index score of at least 0.9, consume considerable amounts of energy. The populations of all countries that have reached a high level of development also have close to 100 per cent access to electricity. A global comparison of household expenditures for fuel and electricity reflects that, in many cases, developing countries, particularly those with low household incomes, have to allocate larger

shares of their income to cover energy expenditures than developed countries, making the affordability of modern energy services even more challenging.[29]

53. However, despite the indispensable role that access to modern energy plays in sustainable development, affordability is a major constraint which can limit the use of some modern energy services in developing countries. Modern energy services that currently depend mainly on fossil fuels are not affordable for a large share of the population in some developing regions of the world. Moreover, medium and low-income economies importing fossil fuel are particularly vulnerable to price volatility and price increases, which could upset their external payments balance, cause economic instability at the macro level and prevent Governments from investing in technical and social infrastructure, resulting in higher energy costs for households.

Figure XIII
Human development index and total primary energy requirements



Source: United Nations Development Programme, *Human Development Report 2007/2008: Fighting Climate Change: Human Solidarity in a Divided World*, New York, UNDP, 2007.

B. Renewable and advanced energy technologies

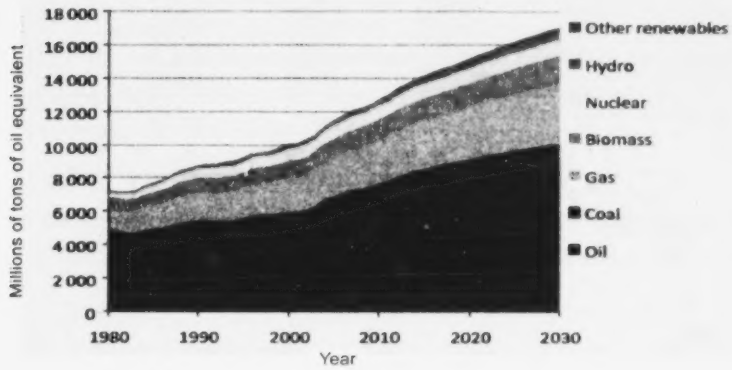
54. Global energy demand amounted to 11,730 million tons of oil equivalent in 2006 and is expected to rise continuously in view of the projected increase in the world's population to more than 8 billion by 2030 and rapid economic expansion and industrialization, especially in countries not members of the Organization for Economic Cooperation and Development. Global energy supply still relies heavily (85 per cent) on fossil energy sources, mainly oil, gas and coal.

55. Deforestation and forest degradation are the primary sources of carbon emissions from some developing countries. In 2004, the forest sector accounted for the release of approximately 8.5 gigatons of carbon dioxide equivalent, mostly from deforestation, which contributes 17.4 per cent of all human-generated carbon dioxide emissions.

[29] United Nations Development Programme, *Human Development Report 2007/2008: Fighting Climate Change: Human Solidarity in a Divided World*, New York, UNDP, 2007, and International Energy Agency (IEA), *World Energy Outlook 2008*, Paris, IEA, 2008.

56. In the reference scenario of the International Energy Agency (IEA), global primary energy demand is projected to increase by 45 per cent from 2006 to 2030.[30] Total energy demand in non-OECD countries is foreseen to increase by 73 per cent, compared with an increase by 15 per cent in OECD countries[31] (see figure XIV). Energy supplies would continue to be based primarily on fossil fuels, with coal projected to account for more than a third of incremental global energy demand through 2030.

Figure XIV
Global primary energy demand, by fuel, in the International Energy Agency reference scenario



Source: International Energy Agency, *World Energy Outlook 2008*, Paris, IEA, 2008.

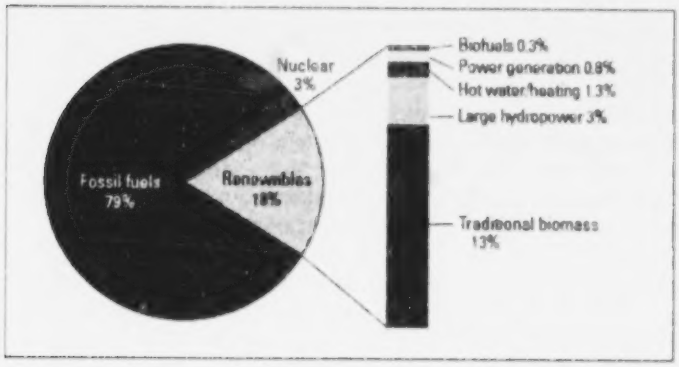
57. There has been remarkable growth and penetration of renewable forms of energy into global markets in recent years, although the share in global energy supply remains low (see figure 16). Renewable energy from wind, solar, small hydro (excluding large hydro), modern biomass (including biofuels but excluding traditional biomass) and geothermal sources supply 2.4 per cent of the world's final energy consumption. Renewable energy comprises about 5 per cent of global power-generating capacity and supplies about 3.4 per cent of global electricity generation. Wind sources currently have the largest share in renewable electric power capacity, followed by small hydro. Biomass, solar and geothermal sources provide hot water and space-heating for tens of millions of buildings. In the transportation sector, biofuels play a significant role, although their contribution is still rather small.[32]

[30] International Energy Agency (IEA), *World Energy Outlook 2008*, Paris, IEA, 2008.

[31] Energy Information Administration (EIA) of the United States, *International Energy Outlook 2009*, Washington D.C., EIA, 2009.

[32] Renewable Energy Policy Network for the 21st Century (REN21), *Renewables 2007: Global Status Report*, Paris, REN21 Secretariat, and Washington, D.C., Worldwatch Institute, 2008.

Figure XV
Share of renewable energy in global final energy consumption



Source: Renewable Energy Policy Network for the 21st Century (REN21), *Renewables 2007: Global Status Report*, Paris, REN21 Secretariat, and Washington, D.C., Worldwatch Institute, 2008.

58. Despite this low share in global power-generating capacity, global investment in sustainable energy reached record levels in 2008, with new investments reaching US$ 155 billion. The first three quarters of 2008 saw financial investment grow to US$ 95 billion, 33 per cent higher than for the same period in 2007. However, owing to the financial and economic crisis, in the second half of 2008 investment declined by 17 per cent over that of the first half.[33] However, projects continued to progress and many economic stimulus bills included components for supporting renewable energy. At the same time, development assistance for renewables in developing countries expanded greatly, reaching about US$ 2 billion in 2008. By early 2009, policy targets existed in at least 73 countries, and at least 64 countries had policies to promote renewable power generation, including 45 countries and 18 states/provinces/territories with feed-in tariffs, and many of these were recently updated.(see box 11).

59. Therefore, the question is no longer whether renewables are an option. Now the question is how to integrate renewable energy into national sustainable development strategies and other comprehensive development plans that help countries to achieve their economic, environmental and social objectives in an integrated manner in order to make them more affordable, especially for developing countries. In addition to climate change mitigation, energy security and energy access, renewable energy can help countries to identify linkages between renewable energy promotion and industrial competitiveness, increasing the eco-efficiency of economies, generating employment, innovating technological advances and creating global partnerships.[34] A variety of complementary policy tools and measures exists

[33] United Nations Environment Programme, Sustainable Energy Finance Initiative, *The Global Financial Crisis and Its Impact on Renewable Energy Finance*, April 2009, http://sefi.unep.org/fileadmin/media/sefi/docs/publications/Study_Financial_Crisis_impact_on_RE.pdf.

[34] United Nations, "Addressing climate change in national sustainable development strategies: common practices", Background Paper No. 12, submitted to the Commission on Sustainable Development at its sixteenth session, New York, 5-16 May 2008.

for promoting renewable energy use. The most common policies are feed-in laws and renewable energy quotas and portfolio standards (see box 11).

Box 11
Policy support for renewables

Policy targets for renewable energy were added, supplemented, revised, or clarified in a large number of countries in 2008, along with many forms of policy support for renewables. For example, new solar photovoltaic subsidy programmes were adopted in Australia, China, Japan, Luxembourg, the Netherlands and the United States. New laws and policy provisions for renewables were adopted in developing countries: Brazil, Chile, Egypt, Mexico, the Philippines, South Africa, Syria and Uganda. New mandates for using solar hot water and other renewable forms of heating were passed in Cape Town, South Africa; Baden-Württemberg, Germany; Hawaii, United States; Norway and Poland. New mandates or targets for blending appeared in at least 11 countries, including a new 20-per cent target in India. The number of consumers of so-called green power grew to more than 5 million households and businesses worldwide. City and local government policies became a growing segment of the policy landscape, with several hundred cities and local governments around the world actively planning or implementing renewable energy policies and planning frameworks linked to efforts to reduce carbon dioxide emissions.

Source: Renewable Energy Policy Network for the 21st Century (REN21), *Renewable Global Status Report, 2009 Update*, Paris, REN21 Secretariat, 2009.

Box 12
Global feed-in-tariffs for renewable energy

Feed-in tariffs help to secure domestic energy supply, accelerate the transition to a low-carbon energy system, create new jobs and industries, guarantee investment security, drive technological and service innovation, provide fair market conditions and drive deployment faster, more equitably and cheaply than other policies.

The tariffs are legally guaranteed payments for electricity produced by green forms of energy, such as solar, wind, biomass or small hydro power, and fed into the national electricity grid. These long-term payments to operators of renewable energy installations, be they households, businesses, communities or utilities, are differentiated by scale and technology. This differentiation is based on what it actually costs to produce energy from each technology in order to ensure a reasonable profit. As costs decline and the technology nears grid parity, so do the payments. This encourages faster deployment and creates pressure on manufacturers to increase efficiency and improve overall product design and delivery. One gets paid only for the energy he or she produces; thus, the equipment must be as efficient as possible. Legal measures ensure stability and investment security. Because feed-in tariffs

ensure deployment, a mass market can be created, which continually increases technological efficiency. The system improves conditions for deployment in the developing world as people can get cheaper electrical power from solar and wind energy on site, without the necessity of a grid. The systems are often funded by a small increase in the cost of all consumers' utility bills, which makes the cost increase very minor, particularly in view of the multiple economic, social and environmental benefits. Owing to more predictable revenue streams from renewable energy projects, feed-in tariffs can attract investment. Wind power and solar photovoltaic energy especially have increased significantly as a result of feed-in tariffs.

Source: World Future Council (www.worldfuturecouncil.org/arguing_fits.html).

60. Having electricity grids that use new and renewable sources of energy would be important, but such a system should be accompanied by legal guarantees as a precondition for private-sector investments. Most countries that have undertaken recent electricity sector and market reforms now provide conditional access to the grid for independent power producers, including small-scale renewable energy producers. In liberalized electricity markets, electricity retailers seek to sell electricity from new and renewable energy sources as "green electricity", at a premium price, to environmentally conscious consumers. Many countries also use public-benefit funds to finance rural electrification, renewable energy, energy efficiency or public research projects. Other important policy tools include public competitive bidding, direct public financing and investment to promote renewable energy. In response to the financial and economic crisis, several Governments have adopted economic stimulus packages focused on the new green employment opportunities that the renewable energy sector offers. It is important that those packages be channelled into sustainable investments in renewable energy, energy efficiency and transport.[35]

61. It is also important to underline the importance of research. Currently, the world is investing barely US$ 2 per person per year in energy-related research, development and deployment activities. This needs to increase by a factor of 2 to 3 in order to enable the transition towards new and advanced technologies in energy systems.[36]

C. Energy efficiency

62. Energy efficiency offers a powerful and cost-effective tool for achieving a sustainable energy future. Improvements in energy efficiency can reduce the need for investment in energy infrastructure, cut fuel costs, increase competitiveness and improve consumer welfare.

[35] See A/64/277.

[36] United Nations, *Millennium Development Goal 8: Strengthening the Global Partnership for Development in a Time of Crisis: MDG Gap Tasks Force Report 2009.* (United Nations publication, Sales No. E.09.I.8); see also website (www.un.org/esa/policy/mdggap/mdg8report_engw.pdf).

63. However, shifts in energy demand and supply according to the so-called 550 policy scenario (involving "cap-and-trade measures, sectoral agreements and national measures to keep carbon dioxide levels below 555 ppm) would require a total of US$ 4.1 trillion more investment between 2010 and 2030 than in the "Reference Scenario", which equals on average 0.24 per cent of annual global GDP. Most of this funding would be spent on improving existing technologies. Thus, investment in power plants would US$ 1.2 trillion higher. Additional expenditures also come from individuals who need to purchase more efficient cars, appliances and buildings. This extra cost would amount to US$ 17 per person per year on average throughout the world, but at the same time this would lower energy bills. Improved energy efficiency lowers fossil fuel consumption by a cumulative amount of 22 million tons of oil equivalent over the period 2010-2030 and could yield cumulative savings of over US$ 7 trillion.[36] Thus, a number of programmes are based on improving energy efficiency (see box 13) at the international, regional, national and local levels (see box 14).

Box 13
Global climate corps for energy efficiency

"Climate Corps" is the first programme of its kind to put the financial and analytical skills, as well as a passion for the environment, of master of business administration students to work in developing an economic rationale for energy efficiency. Recruits from top business schools undergo intensive training in fundamental energy efficiency strategies. They are then placed as "Climate Corps Fellows" at carefully selected companies which have agreed to supply a dedicated high-level project sponsor, grant access to relevant areas of the company and ultimately take action. Over the course of 10-12 weeks, the fellows develop detailed business cases from which they would make their final recommendations. The end result is a thoroughly researched set of recommendations and tools to drive the company's next steps. Results from the first year of the programme's operations demonstrate the impact of this innovative approach.

Source: Environmental Defense Fund (www.edf.org/home.cfm).

Box 14
The Equipment Energy Efficiency Programme

The is a collection of coordinated end-use energy efficiency programmes in Australia and New Zealand that provide the community with economic and environmental benefits. It focuses on programmes that require a nationally consistent framework to improve energy efficiency and reduce greenhouse gas emissions from household appliances and equipment and commercial and industrial equipment. The main tools used are mandatory minimum energy performance standards, energy efficiency labelling (enforced by law) and voluntary measures, including endorsement labelling, training and support, to promote the best products available. These tools have been used in order to improve

the energy efficiency of refrigerators and freezers. The star-rating energy label was introduced for use on refrigerators and freezers in late 1986. Energy consumption reductions were enhanced with the introduction of the standards in 1999. Between 1980 and 2006, the overall energy consumption of refrigerators was reduced by 67 per cent. In addition, the combination of labelling and standards has delivered to the market refrigerators that use one third less energy but also provide additional benefits, such as being frost-free. From 1 April 2010, a new energy label design and star-rating algorithm will have been put into force. The new algorithm is based on a function of adjusted volume to the power of 0.67 to better reflect changes in surface area by size.

64. Buildings are responsible for at least 40 per cent of energy use in most countries. There are three main approaches to energy neutrality: cutting buildings' energy demand, producing energy locally and sharing energy by creating buildings that can generate surplus energy and feed it into an intelligent grid infrastructure.[37]

65. Efficiency gains in buildings are likely to provide the greatest energy reductions and in many cases will be the most economical option. A study by McKinsey[38] estimated that demand reduction measures with no net cost could almost halve expected growth in global electricity demand (see box 15).

Box 15
Energy efficiency campus in India

RETREAT is a part of the Gual Pahari campus of TERI (The Energy and Resources Institute), located about 30 km south of New Delhi. It demonstrates efficient use of natural resources, clean and renewable energy technologies and efficient waste management. The 3,000 sq metre training centre is independent of the city's electricity grid system. The peak electricity load is only 96 kW, compared with the conventional peak of 280 kW. Its design had three important aspects: the functionality of the building and how energy is used in it; "passive" concepts that minimize energy demand, such as solar orientation, latticework for shading, insulation and landscaping; and space conditioning and lighting demands that are met through energy-efficient systems using renewable energy sources.

Source: World Business Council for Sustainable Development (WBCSD), *Energy efficiency in buildings: Transforming the Market*, Geneva, WBCSD, 2009.

[37] World Business Council for Sustainable Development (WBCSD), *Energy Efficiency in Buildings: Transforming the Market*, Geneva, WBCSD, 2009.

[38] Per-Anders Enkvist, Tomas Nauclér and Jerker Rosander, "A cost curve for greenhouse gas reduction", *The McKinsey Quarterly*, No. 1, 2007.

VI. Protecting and managing the natural resource base

66. The recent financial and economic crisis that led the world into recession is not only indicative of imperfections in the global economic and financial system, but also an indication of a still-imperfect balance in the use of natural, human, social, economic and financial capital in the pursuit of sustainable development. Global economic growth over the past 50 years has been achieved at a huge cost to the environment and ecosystems. While global GDP more than doubled between 1981 and 2005, 60 per cent of the world's ecosystems have been degraded or exploited unsustainably in the meantime.[39] Poor management of the natural resource base in ways that consume rather than renew natural capital has crucial implications for people's livelihood and well-being.

67. Research has shown that, over the past 50 years, humans have changed ecosystems more rapidly and extensively than in any comparable period of time in human history, largely in order to meet rapidly growing demands for food, fresh water, timber, fibre and fuel. The changes that have been made in ecosystems have contributed to substantial net gains in human well-being and economic development, but these gains have been achieved at growing costs in the form of the degradation of many ecosystem services, increased risks of non-linear changes and the exacerbation of poverty for some groups of people. These problems, unless addressed, will substantially diminish the benefits that future generations obtain from ecosystems.[39]

68. The challenge of reversing the degradation of ecosystems while meeting increasing demands for their services can be partially achieved if policies, institutions and practices are changed. Options exist to conserve or enhance specific ecosystem services in ways that reduce negative trade-offs or that provide positive synergies with other ecosystem services.[39]

69. In recent years, a significant amount of research and field programmes have been developed around the concept of "payments for ecosystem services", which seeks to create effective incentives for conservation and the sustainable use of ecosystems and the services that they provide (see box 16). At the international level, such payments can encourage transfers from the international community to countries and communities that are home to important ecosystems, where local action can provide global public goods. Gradually, mechanisms are appearing in a number of areas, such as habitat conservation, sediment control or carbon sequestration.

[39] Millennium Ecosystem Assessment, *Ecosystems and Human Well-being: Synthesis*, Washington D.C., Island Press, 2005.

Box 16
Clean development mechanism and payments for ecosystem services

Through mechanisms such as the clean development mechanism set up under the Kyoto Protocol to the United Nations Framework Convention on Climate Change (FCCC/CP/1997/7/Add.1, decision 1/CP.3, annex), the carbon market currently provides the most developed form of payments for ecosystem services operating at the international level. Projects under the clean development mechanism deliver carbon offsets in developing countries, which then receive payments from carbon emitters in developed countries. Similar approaches can and should be envisaged for a range of other ecosystem services, such as biodiversity. Further economic analysis to inform policy decision is expected to result from the ongoing work on the economics of ecosystems and biodiversity study (see http://ec.europa.eu/environment/nature/biodiversity/economics/) and similar initiatives at the international level.

A. Managing fragile ecosystems

70. Fragile ecosystems, such as those in drylands and coastal zones, are vulnerable to climate change but can also, if adequately protected, serve to buffer the impacts of climate change, including from extreme weather events, and facilitate adaptation. The stresses from climate change are added to those from high population density and overexploitation. Sound management practices are essential for maintaining healthy ecosystem functions in the face of such pressures.

71. Three major problems associated with mankind's management of the world's ecosystems are already causing some people significant harm, particularly the poor. Unless they are addressed, these problems will substantially diminish the long-term benefits humanity will obtain from ecosystems. First, approximately 60 per cent (15 out of 24) of the ecosystem services examined during the Millennium Ecosystem Assessment are being degraded or used unsustainably. These services include fresh water, capture fisheries, air and water purification and the regulation of regional and local climate, natural hazards and pests. Second, there is established, but incomplete, evidence that changes being made in ecosystems are increasing the likelihood of non-linear changes in ecosystems and these have important consequences for human well-being. Third, the harmful effects of the degradation of ecosystem services are being borne disproportionately by the poor, thus contributing to growing inequities and disparities across groups of people, and sometimes they are the principal factor causing poverty and social conflict.[39]

1. Combating desertification and drought

72. Desertification is caused by climate variability and human activities while drought is mostly a result of changing weather patterns. The impact of drought is exacerbated by activities such as overgrazing and using poor cropping methods, which reduce the water retention of the soil, and improper soil conservation

techniques, which lead to soil degradation.[40] Desertification adversely affects agricultural productivity, the health of humans as well as that of livestock, and economic activities such as ecotourism (see box 17).

Box 17

Desertification and drought are at the core of serious challenges in Africa

There are extensive agricultural drylands in Africa, almost three quarters of which are already degraded to some degree (United Nations Convention to Combat Desertification: Fact sheet 11, "Combating desertification"). They are major environmental and socio-economic problems with negative effects on the livelihood of populations in many African countries. Africa's desertification is strongly linked to poverty, migration and food security, and it threatens sustainable development. The Dar-es-Salaam Declaration on Agriculture and Food Security in the SADC Region is a welcome development towards achieving sustainable management of natural resources. As a result of frequent droughts, attention is being given to programmes on drought and food security. Large investments in irrigation have resulted in the area under irrigation that grew from 1.63 million hectares in 1985 to an estimated 1.96 million hectares in 2005. In addition, investments are being made in research and development of drought-tolerant seed varieties (South African Development Community Dar-es-Salaam Declaration of Agriculture and Food Security in the SADC Region (www.sadc.int/index/browse/page/173); see also E/CN.17/2008/6).

Source: Economic Commission for Africa, *Africa Review Report on Drought and Desertification*: Section 2: "Overview of drought and desertification situation in Africa", Addis Ababa, UNECA, 2008.

73. The most obvious impact of desertification, in addition to producing widespread poverty, is the degradation of 3.3 billion hectares of the total area of rangeland, constituting 73 per cent of the rangeland with a low potential for human and animal carrying capacity; the decline in soil fertility and soil structure on about 47 per cent of the dryland areas constituting marginal rain-fed cropland; and the degradation of irrigated cropland, amounting to 30 per cent of the dryland areas with high population density and agricultural potential. Desertification is already responsible for significant forced migration; more than a billion people — one in seven of the current global population — could be forced from their homes between now and 2050 if climate change worsens.[41]

2. Coastal zone management

74. Coastal ecosystems across the globe continue to be threatened by urban expansion, ribbon development, poor management of watersheds and the destruction

[40] See E/CN.17/2008/6.

[41] United Nations Convention to Combat Desertification: Fact sheet 10, "Desertification, global change, and sustainable development".

of habitat. As much as 91 per cent of all temperate and tropical coasts are likely to experience heavy impacts as a result of such development by 2050. Key threats to coastal ecosystems, including coastal plains, headlands, estuaries, deltas, intertidal zones, bays and near-shore marine waters, include oil spills, untreated sewage and industrial wastewater, heavy siltation, nutrient enrichment, invasive species, persistent organic pollutants, heavy metals, radioactive substances, marine litter, overfishing, unchecked development and the physical alteration and destruction of key coastal habitats, such as mangroves, wetlands, foreshore dune systems, coral reefs and seagrass meadows. These impacts will be compounded by a rise in sea level and acidification and the increased frequency and intensity of storms that easily break down and damage beaches and coast lines.

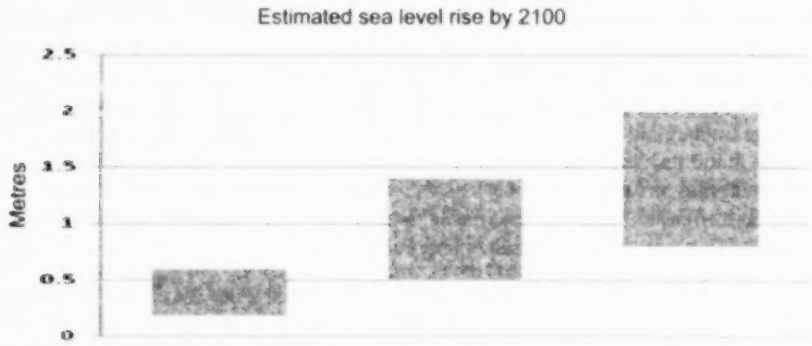
75. The cumulative effect of these pressures is severely reducing the productivity of coastal ecosystems vital for human life and economic development since coastal zones of the world host many activities, including industrial and business activities, fisheries, energy facilities, marine transportation, and recreation and tourist activities. According to a United States environmental report, two thirds of the world's fish catch and many marine species, depend on coastal wetlands for their survival (see figure XVI).

Figure XVI
Coastal population and shoreline degradation

Source: United Nations Environment Programme.

76. Global climate change may result in flooding that would threaten lives, agriculture, livestock, buildings and infrastructure. Living within 1 metre of high tide are 8-10 million people. The Intergovernmental Panel on Climate Change (IPCC) has proven that the most vulnerable populations live in the developing world on mega deltas, small island developing States, and cities by the sea, such as Dhaka; Jakarta; Mumbai, India; and Shanghai, China. In Asia alone the number of people at risk exceeds 60 million (see also figure XVII).

Figure XVII
Comparison of recent estimates of sea level rise by 2100, relative to 1990 levels



Source: Intergovernmental Panel on Climate Change, 2007.

77. The Coastal Zone Management Subgroup of IPCC has examined the physical and institutional strategies for adapting to the potential consequences of global climate change. Coastal management programmes usually include governmental controls and private sector incentives. Vulnerable areas are managed to minimize loss of life and property through such means as setback lines, limits on population densities, minimum building elevations and coastal hazard insurance requirements (see figure XVIII). Resilient natural protective features, such as beaches, sand dunes, mangroves, wetlands and coral reefs, are conserved and enhanced, which also maintains biological diversity, aesthetic values and recreation[42] (see box 18).

Box 18
Coastal management programme in the United States

This programme is a partnership between the Office of Ocean and Resource Management of the National Oceanic and Atmospheric Administration (NOAA) of the United States Department of Commerce and 34 coastal and Great Lakes states, territories and commonwealths. The partnership works to preserve, protect, develop and, where possible, restore and enhance the country's coastal zone resources. According to NOAA, these programmes together protect more than 99 per cent of the country's 95,331 miles of ocean and Great Lakes coastlines. As a result, tourism and recreation continue to add value to the country's fastest-growing business sectors, with some 180 million people visiting the coastal areas each year. The coastlines are home to almost 153 million people, or about 53 per cent of the total United States population. On average, about 3,600 people relocate to these coastal areas each day and, by 2015, it is estimated that the coastal population would reach 165 million.

Source: United States Department of Commerce, National Oceanic and Atmospheric Administration (NOAA), Office of Ocean and Resource Management, April 2009. Accessible from http://coastalmanagement.noaa.gov/programs/czm.html.

[42] Intergovernmental Panel on Climate Change (IPCC) Response Strategies Working Group, *Report of the Coastal Zone Management Subgroup of the IPCC Response Strategies Working Group*, 1990.

Figure XVIII

Estimate of marginal costs involved in protecting countries worldwide against the effects of a 1 metre sea level rise in 100 years

	Region	*Total protective costs (billions of United States dollars)*	*Total costs per capita (United States dollars)*	*Annual protective costs as a percentage of GNP*
1	North America	106.2	306	0.03
2	South America	3.0	117	0.12
3	Caribbean islands	11.1	360	0.20
4	South America (Atlantic Ocean coast)	37.6	173	0.09
5	South America (Pacific Ocean coast)	1.7	41	0.04
6	Atlantic Ocean (small islands)	0.2	333	0.12
7	Northern and Western Europe	49.8	196	0.02
8	Baltic Sea coast	28.9	429	0.07
9	Northern Mediterranean	21.0	167	0.04
10	Southern Mediterranean	13.5	87	0.06
11	Africa (Atlantic Ocean coast)	22.8	99	0.17
12	Africa (Indian Ocean coast)	17.4	98	0.17
13	Gulf States	9.1	115	0.02
14	Asia (Indian Ocean coast)	35.9	34	0.14
15	Indian Ocean (small islands)	3.1	1 333	0.91
16	South-eastern Asia	25.3	69	0.11
17	Eastern Asia	37.6	38	0.02
18	Pacific Ocean (large islands)	35.0	1 150	0.17
19	Pacific Ocean (small islands)	3.9	1 809	0.75
20	Russian Federation	25.0	89	0.01
	Total	**488.1**	**103**	**0.04**

Source: United States Department of Commerce, National Oceanic and Atmospheric Administration (NOAA), April 2009. Accessible from http://coastalmanagement.noaa.gov/programs/czm.html.

78. Under the auspices of the UNEP Global Programme of Action for the Protection of the Marine Environment from Land-based Activities[43] and the respective Regional Seas Conventions and Action Plans,[44] the global community has taken significant steps towards comprehensive, continuing and adaptive action to protect fragile coastal ecosystems. Particular emphasis is being placed on building national capacity to implement ecosystem-based management at the interface of land and sea, mainstreaming the protection of coastal ecosystems with national development planning and adapting to climate change.

[43] See www.gpa.unep.org.

[44] See www.unep.org/regionalseas.

3. Mitigation of natural disasters

79. Natural disasters have caused enormous losses in many countries and have set back economic progress in developing countries by years. Vulnerability to disasters is linked to several factors, such as population growth, unplanned development and climate change. Droughts, floods, cyclones, landslides, earthquakes and tsunamis are the major types of disaster phenomena occurring in different regions of the world.

80. Sustainable development requires that the natural resource base be protected and enhanced and that institutions be established to promote equitable growth, both factors being essential for reducing disaster hazard risk and vulnerability[45] (see figures XIX and XX). Several organizations in the United Nations system, including UNESCO, the World Meteorological Organization, WHO and UNDP are planning substantial new and continuing activities towards reducing the risk and vulnerability of natural disasters[46] (see box 19).

Box 19

Disaster reduction and risk management in Armenia, Latin America and the Caribbean and Viet Nam

In Armenia, disaster risk education is promoted in schools and through the mass media by a women's development group. This group emphasizes disaster mitigation and focuses on mothers and teachers, fostering seismic protection skills among children.

In Latin America and the Caribbean, programmes and structures for disaster risk management have been established within ministries of health.

In Viet Nam, under the National Strategy for Natural Disaster Prevention, Response and Mitigation, 36 projects will have been developed between 2009 and 2025, at a total cost of over VND 215 trillion (almost $12 billion). According to the head of the National Steering Committee for Flood and Storm Control, since the beginning of 2010, 300 people have been killed or are missing and 963 injured by storms affecting the country, with the total damage estimated at over VND 24.4 trillion ($1.55 billion). Knowledge related to climate change, response to storms and floods and mitigation of natural disasters will be included in school curricula.

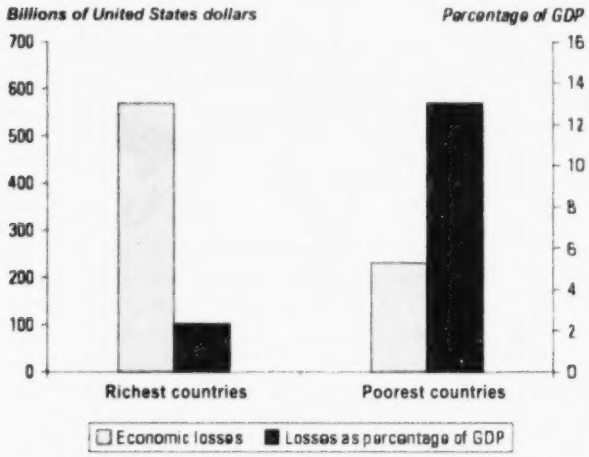
Source: United Nations International Strategy for Disaster Reduction, *Living with Risk: A Global Review of Disaster Reduction Initiatives, 2004 version* (United Nations publication, Sales No. GV.03.0.2, and World Health Organization, *World Health Report 2002*, Geneva, WHO, 2002. See also http://files.dcp2.org/pdf/DCP/DCP61.pdf and www.saigon-gpdaily.com.vn/National/2009/10/74961/.

[45] See EGM/NATDIS/2001/Rep.1.

[46] Frank Press and Robert M. Hamilton, "Mitigating natural disasters", editorial, *Science*, vol. 284, No. 5422, p. 1927.

Figure XIX

Disaster losses, total and as a share of GDP in the richest and poorest countries, 1985-1999



Source: United Nations International Strategy for Disaster Reduction, *Living with Risk: A Global Review of Disaster Reduction Initiatives, 2004 version* (United Nations publication, Sales No. GV.03.0.2).

Figure XX

Annual growth of GDP and occurrence of major natural disasters in Ecuador, 1980-2001

Source: United Nations International Strategy for Disaster Reduction, *Living with Risk: A Global Review of Disaster Reduction Initiatives, 2004 version* (United Nations publication, Sales No. GV.03.0.2).

81. The frequency and the intensity of disasters are expected to grow very rapidly worldwide. The risks are particularly severe in cities around the Equator, in Africa, the river deltas of South-eastern Asia, the Amazon River Basin area, low-lying islands and cities located near oceans (see figure XXI).

Figure XXI
Large cities in relation to current climate-related hazards

Source: Alexander de Sherbinin, A. Schiller and A. Pulsipher, "The vulnerability of global cities to climate hazards", *Environment and Urbanization*, vol. 19, No. 1, pp. 39-64.

Note: Hazard risk represents a cumulative score based on the risk of cyclones, floods, landslides and drought.

B. Biodiversity and conservation of biological resources

82. Many people have benefited over the last century from the exploitation of biodiversity. At the same time, however, these gains have been achieved at growing costs in the form of losses in biodiversity and the exacerbation of poverty for other groups of people. The most important direct drivers of biodiversity loss and ecosystem service changes are (a) habitat change, such as land use changes, physical modification of rivers or withdrawal of water from rivers, loss of coral reefs and damage to sea floors as a result of trawling; (b) climate change; (c) invasion of alien species; (d) overexploitation; and (e) pollution.[39] Biodiversity loss has negative effects on several aspects of human well-being, such as insecurity with regard to food and energy, vulnerability to natural disasters and difficult access to clean water and raw materials. It also adversely affects human health, social relations and freedom of choice[47] (see box 20).

Box 20
European Union battle to halt biodiversity loss

In order to achieve agreement in the European Union, Heads of State or Government have agreed on a stronger commitment "to halt the loss of Europe's biodiversity by 2010 and beyond" (Meeting of the European Council, Gothenburg, Sweden, 15 and 16 June 2001). One of the European Commission's largest contributions to the fight against biodiversity loss is the Natura 2000 network. This is now the largest ecological network in the world, consisting of around 25,000 sites spread across 27 countries and covering an area bigger than the Amazon River

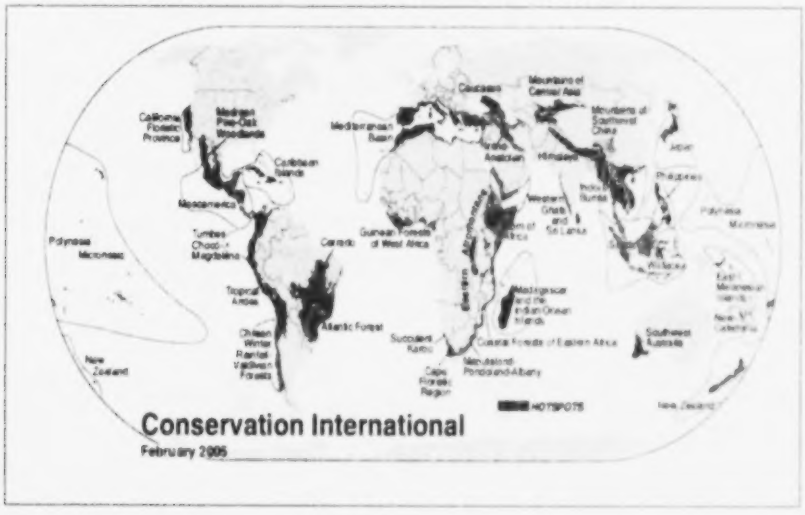
[47] GreenFacts et al., *Facts on Biodiversity: A Summary of the Millennium Ecosystem Assessment Biodiversity Synthesis* (www.greenfacts.org/en/biodiversity/biodiversity-foldout.pdf).

basin. The green infrastructure it affords serves to safeguard numerous ecosystem services and ensures that Europe's natural systems remain healthy and resilient. The network makes it possible for rare animals, such as otters, beavers and wolves, to repopulate areas from which they have been absent for centuries. It also serves to reconnect an increasingly urban society with nature (see www.europa-eu-un.org/articles/en/article_7889_en.htm).

Source: European Parliament Policy Department Economic and Scientific Policy: The Problem of Biodiversity Loss in the EU, Briefing Note 631-605.

83. Biodiversity is continuously being both generated and lost, but currently the rate of biodiversity loss exceeds the rate of creation.[48] The world's most remarkable places are also the most threatened. These are "hotspots", that is, the richest and most threatened reservoirs of plant and animal life. According to the Conservation International Report, the biodiversity hotspots hold especially high numbers of endemic species, yet their combined area of remaining habitat covers only 2.3 per cent of the Earth's land surface. Each hotspot faces extreme threats and has already lost at least 70 per cent of its original natural vegetation. Over 50 per cent of the world's plant species and 42 per cent of all terrestrial vertebrate species are endemic to 34 biodiversity hotspots[49] (see figure XXII).

Figure XXII
The world's biodiversity hotspots



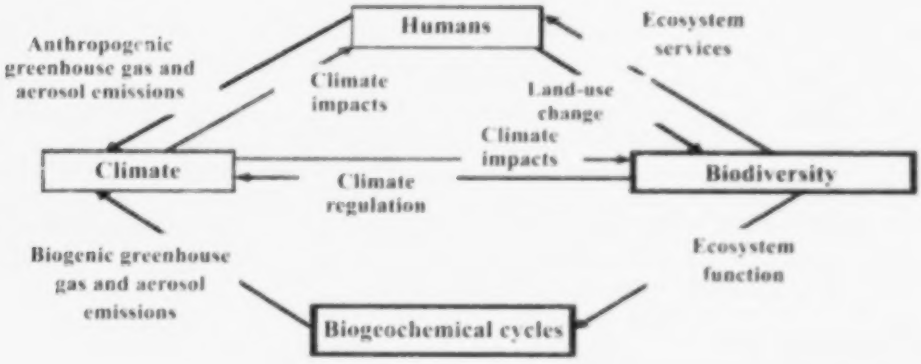
Source: Conservation International, 2005.

[48] UNDP, *Biodiversity and Sustainable Land Management in Europe and CIS*, http://europeandcis.undp.org/environment/bdslm/show/FA592BD6-F203-1EE9-B37E7C4CE76751C6.

[49] Conservation International, *The Biodiversity Hotspots* (www.conservation.org/explore/priority_areas/hotspots/pages/hotspots_main.aspx).

84. IPCC has concluded that, if temperature rises exceed the norm by 1.5-2.5°C, appropriately 20-30 per cent of the plant and animal species assessed are likely to be at risk of extinction.[50] Biodiversity is necessary for human well-being and climate regulation; therefore, it must be central to the development of adaptation and mitigation programmes (see figure XXIII). Between 12 per cent and 52 per cent of species within well-studied areas are threatened with extinction.[51]

Figure XXIII
Linkages between human well-being, biodiversity and climate change



Source: The Royal Society, 2008.

85. Response options to conserve biodiversity and promote human well-being have to come from all levels, global, national, regional and local, because loss of biodiversity is driven by factors at all these levels. The options also need to acknowledge the different needs of multiple stakeholders. Further progress in reducing biodiversity loss will come through greater coherence and synergies among sectoral responses and through more systematic consideration of trade-offs among ecosystem services or between biodiversity conservation and other needs of society.[39]

C. Oceans and marine resources

86. Changes in marine ecosystems are being driven primarily by relatively small increases in ocean temperature, acidity and sea level (see figure XXIV), although other factors, such as coastal desertification and more intense storms, are placing increasing pressure on marine ecosystems.[51] Loss of marine habitats and biological diversity continues, with more than 10,000 species considered to be under threat.[52]

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[50] See Intergovernmental Panel on Climate Change (IPCC), R. K. Pachauri and A. Reisinger, eds., *Climate Change 2007: Synthesis Report*, Contribution of Working Groups I, II and III to the Fourth Assessment Report of the IPCC, Geneva, IPCC, 2007.

[51] The Royal Society, *Biodiversity — Climate Interactions: Adaptation, Mitigation and Human Livelihoods: Report of an International Meeting*, London, The Royal Society, 2007, p. 3.

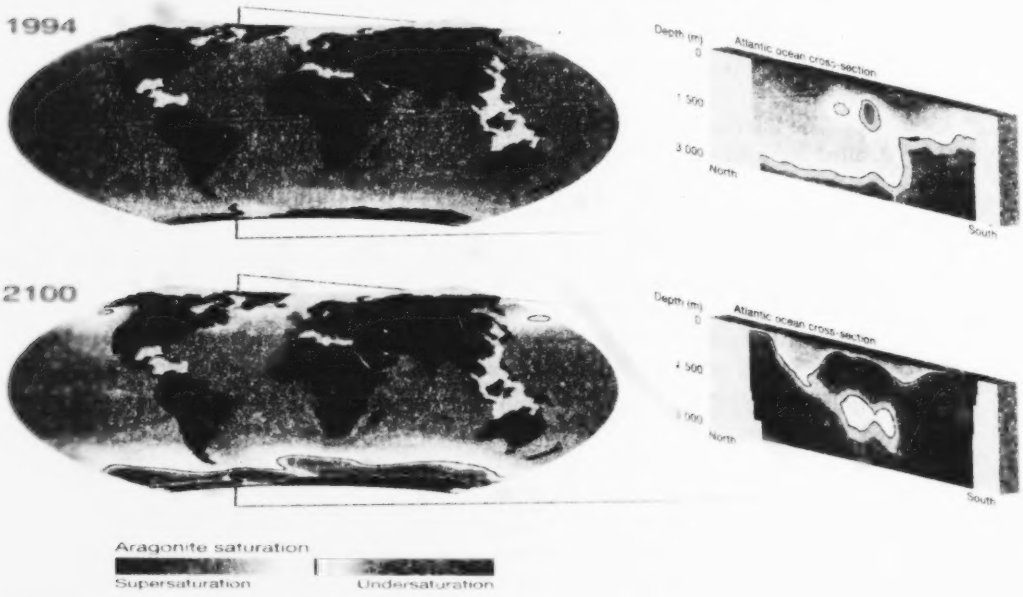
[52] United Nations, *The United Nations Millennium Development Goals Report 2005* (United Nations publication, Sales No. E.05.I.16), p. 31.

87. Marine and coastal ecosystems are among the most productive natural environments and provide a wide range of social and economic benefits essential for human well-being in coastal countries. Furthermore, the health of the ocean, the status of the world's climate and the welfare of human societies are inextricably linked. Oceans play an important role in determining climate by transporting heat around the globe through ocean currents or sinking carbon dioxide, thereby taking it out of the atmosphere; oceans account for about 55 per cent of the world's total biological, or green, carbon captured by living organisms.

88. In turn, oceans are also highly vulnerable to changes in the world's climate. Changes in the climate and atmospheric composition are already having noticeable and devastating effects on the oceans' ecological, chemical and physical processes.

Figure XXIV

Acidification due to climate change and its impacts on oceans and coral reefs

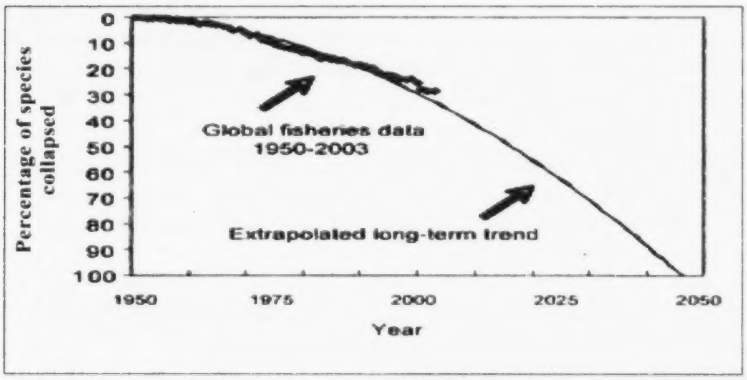


Source: United Nations Environment Programme.

89. Fisheries and other marine resources are being overexploited. The rural poor are the most immediately affected because their day-to-day subsistence and livelihood activities more often depend on the natural resources around them than is the case with other people.[52] Since the 1950s, oceans have lost more than 90 per cent of the large fish that humans rely on for food, income and other purposes. More fish are caught now than oceans can replace[53] (see figure XXV).

[52] For example, nudibranch (Hermissenda crassicornis) (a species of sea slug).

Figure XXV
Global loss of seafood species



Source: *Science*/the Food and Agriculture Organization of the United Nations.

90. The International Maritime Organization (IMO) has joined with a host of other United Nations agencies and leading international scientific bodies in developing the first comprehensive real-time tool to assess the state of the world's oceans in order to reduce the impact of climate change on oceans and maritime resources for sustainable development.

91. IMO is also addressing GHG emissions through the development of an energy efficiency design index for new ships and a ship energy management plan for all ships, which includes guidance on best practices for fuel-efficient ship operations, and an energy efficiency operational indicator, which helps to determine the fuel efficiency of ships.[54]

92. The effects of climate variabilities on marine life have been under observation for decades.[55] By 2050, ecosystems in subpolar regions, the tropics and semi-enclosed seas will have undergone numerous local extinctions. Conversely, the Arctic Ocean and the Southern Ocean will experience severe species invasions. The impacts of climate change on marine biodiversity may result in a dramatic species turnover of up to 60 per cent, according to this first quantitative estimation of marine biodiversity impacts at the global scale.[56]

[54] International Maritime Organization (IMO), "Climate change a challenge to IMO too!" (www.imo.org/about/mainframe.asp?topic_id=1773&doc_id=11855).

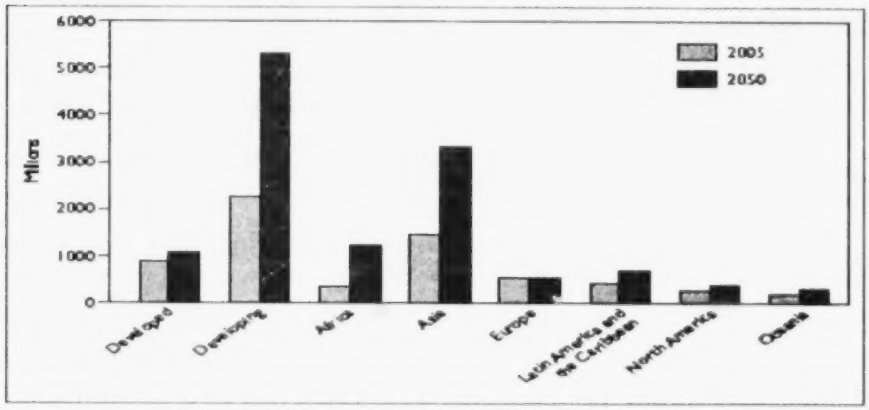
[55] United Nations Environment Programme, *Climate Change Science Compendium 2009* (www.unep.org/compendium2009/PDF/Ch5_compendium2009.pdf), chap. 4, p. 34.

[56] W. W. L. Cheung, V. W. Y. Lam, J. L. Sarmiento, K. Kearney, R. Watson and D. Pauly, "Projecting global marine biodiversity impacts under climate change scenarios", *Fish and Fisheries*, vol. 10, No. 3, pp. 235-251.

VII. Sustainable human settlement development

93. Urbanization is rapidly increasing, especially in developing countries, the cities of which together gain an average of 5 million residents every month.[57] Over half the world's population is now living in urban centres; this trend is expected to increase so that two thirds of the world's population will be urban by 2050.[58] Up to 2030, the great majority (80 per cent) of global urban population growth is predicted to take place in developing countries, putting new pressure on urban governance and planning (see figures XXVI and XXVII).

Figure XXVI
Urban population, by region, 2005-2050

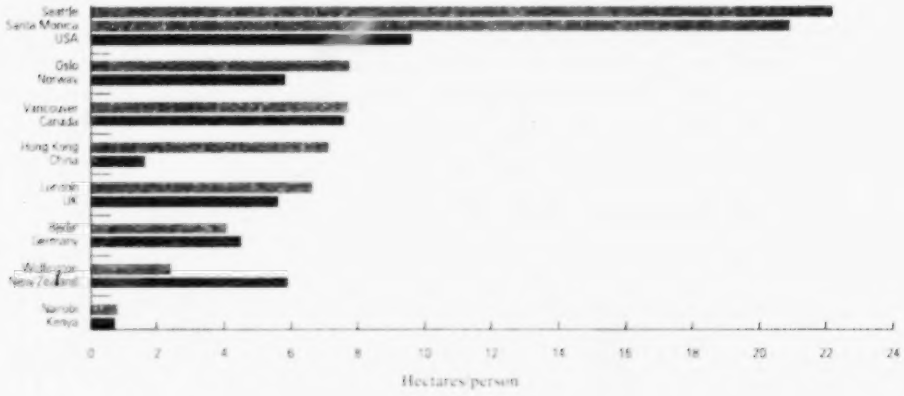


Source: UN-Habitat, Global Report on Human Settlements 2009: Planning Sustainable Cities, Nairobi, UN-Habitat and EarthScan, 2009.
Note: Asia not including Japan.

[57] UN-Habitat, *State of the World's Cities 2008/2009: Harmonious Cities*, Nairobi, UN-Habitat, 2008.

[58] UN-Habitat, *Global Report on Human Settlements 2009: Planning Sustainable Cities*, Nairobi, UN-Habitat and EarthScan, 2009.

Figure XXVII
Ecological footprint of selected cities and countries/areas where they are located



Source: UN-Habitat, *Global Urban Observatory 2008*.
Note: Data are from various sources.

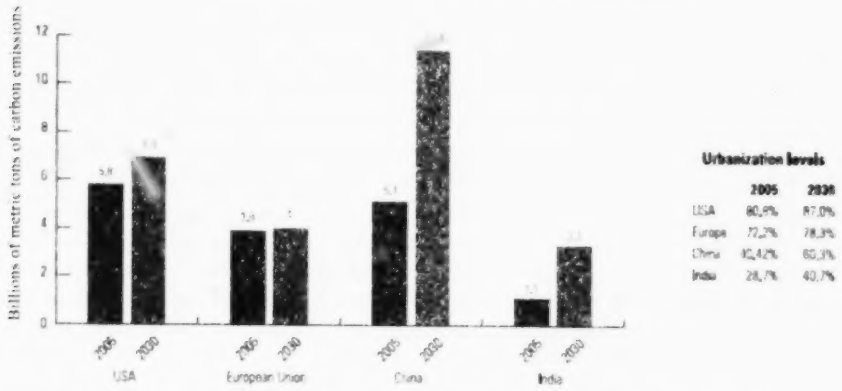
A. Climate change and urban vulnerability

94. With ongoing climate change, mankind is entering a new era of urban vulnerability. The rapid pace of urbanization along with the concentration of an ever-increasing share of the population will also significantly increase the overall vulnerability of urban areas to the impacts of global warming.

95. Rapid urbanization in developing countries holds both threats and opportunities for sustainable development. Cities furnish opportunities to use resources, including land, more efficiently while improving human well-being. Focusing on cities can also be an efficient way to address national, regional and global environmental issues.

96. However, uncontrolled urbanization can be detrimental to human well-being and socio-economic development; such urbanization is a key contributor to environmental issues inside and outside the city, such as the unsustainable use of ecosystems supplying cities with resources and the contribution of cities to global issues, such as coastal/marine pollution (see figure XXVIII).

Figure XXVIII
Carbon emissions and urbanization levels in selected economies



Source: *World Energy Outlook 2007: China and India Insights*. Paris, IEA, 2007. United Nations, *World Urbanization Prospects: The 2005 Revision* (United Nations publication, Sales No. E.06.XIII.5).

B. Intertwined nature of urbanization and infrastructure

97. Cities and urban areas function as ecosystems, with metabolisms that depend on surrounding and far-flung ecosystems, their resources and services. Infrastructural works outside cities, such as harbours, airports, waste dumps and dams, often provide cities with services and resources, and thus are closely linked with cities/urbanization. Currently, many of these forms of infrastructure are failing and are having a negative impact on human well-being and ecosystems, for example waste management and sewerage systems.

98. A city's development, that is, its access to markets and ability to foster human well-being in terms of livelihood and health, is a function of its infrastructure, which generally refers to energy, water, housing, sanitation, waste management, transit systems and food supplies.

99. Urban infrastructure in developed countries, while allowing for rapid economic expansion, has also caused significant degradation of ecosystems and the planet's environment. For example, expanded road networks have enabled urban and suburban sprawl and have led to higher demands for personal transport and fuel.

100. The key to addressing the sustainability and resilience of cities is to develop infrastructure planning, technology and systems which function in "closed loop" or "circular metabolism" systems. Such systems mimic the function of natural ecosystems by converting waste into resources and they can be applied broadly, from the design of entire urban areas to entire economies. Cities, especially megacities, in developing countries stand to gain from current innovation and experience in greening their planning and city development function.

VIII. Means of implementation

101. The global economy is currently deeply mired in the most severe financial and economic crisis since the Second World War. With its increasing impact, both in scope and depth worldwide, the crisis poses a significant threat to global economic and social development, as well as the ability of countries to attain the Millennium Development Goals and other internationally agreed development goals.

102. World gross product (WGP) is expected to have fallen in the baseline scenario by 2.6 per cent in 2009, compared with having grown positively by 2.1 per cent in 2008 and having registered an average annual growth rate of almost 4 per cent per year prior to the crisis during the period 2004-2007. While a mild recovery in WGP growth is possible for 2010, risks remain on the downside. A more prolonged global recession is possible if the vicious cycle between financial destabilization and retrenchment in the real economy cannot be sufficiently contained and farther-reaching, concerted global policy actions are not taken.

103. While the crisis originated in developed countries, which are also leading the economic downturn, developing countries are also being strongly affected through capital reversals, rising borrowing costs, collapsing global trade and commodity prices and subsiding remittance flows. In the baseline scenario, global income per capita is expected to have declined by 3.7 per cent in 2009.

104. At least 60 developing countries, of the 107 countries for which data are available, are expected to suffer declining per capita incomes, while only 7 would register per capita GDP growth of 3 per cent or higher, which is considered as the minimum required growth rate for achieving significant reductions in poverty; this represents a decline from 69 countries in 2007 but an increase over the 51 countries in 2008. Economic setbacks are expected across the board, but will be strongest in the Commonwealth of Independent States, sub-Saharan Africa and Latin America. In addition, the least developed countries will be severely affected, with growth decelerating by 3.5 percentage points from the robust growth witnessed in recent years.[59]

A. Trade

105. The economic and financial crisis has had severe impacts on international trade in most countries, especially developing countries. During 2009, global trade has expectedly declined by 9 per cent. For many developing countries, the crisis is causing a decline in exports and loss of export revenue, diminishing access to trade finance, reductions in export-oriented and infrastructure investment, lower fiscal revenues and balance-of-payment problems.[60] At the same time, trade protectionism is becoming a major concern in the current financial and economic crisis. This situation has added to the already complex process of reforming global trade rules and liberalizing international trade under the Doha round of multilateral trade negotiations and other regional and bilateral initiatives.

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[59] United Nations, *World Economic Situation and Prospects 2009: Update as of Mid-2009* (United Nations publication, Sales No. E.09.II.C.2).

[60] General Assembly resolution 63/303.

106. In the short-run, special attention should also be given to the financing of trade. It has been estimated that more than 90 per cent of trade is financed with some form of short-term credit, insurance or guarantee. However, in the wake of the international financial crisis this short-term credit has begun to dry up. Estimates are that the current liquidity gap in trade finance is about $25 billion.[61] Governments are encouraged to further support the development and expansion of new trade finance facilities by national export credit agencies and international financial institutions.

107. Reforming subsidies remains a key challenge to advance sustainability in the international trading system. It is estimated that the removal of agricultural protectionism could reduce global poverty by as much as 8 per cent.[62] The removal of other subsidies, such as certain fishery and energy subsidies that are clearly harmful to the environment, should also be a priority.

108. Harnessing the potential of trade as an engine of sustainable development could contribute to overcoming the crisis and enhancing the process of change towards a greener, rules-based, open, non-discriminatory and equitable multilateral trading system.

109. Liberalization of trade in environmental goods and services could provide further impetus to green investment. In general, when promoting trade liberalization, care should be taken to avoid or reduce any negative environmental, social and economic impacts, while ensuring global development gains, as well as ways to address potential losses. One of the most effective means of achieving these positive outcomes is to strengthen domestic institutions and the regulations that govern and manage the trade liberalization process and environmental and social protection.

B. Incentives

110. The international community is in the midst of a myriad of challenges to mobilize financial resources in order to respond to the financial and economic crisis and to address climate change and other environmental emergencies, while keeping its focus on leveraging the resources needed to achieve the Millennium Development Goals.

111. A number of developed and emerging market economies have implemented fiscal stimulus packages. It has been estimated that at least 15 per cent of the global stimulus packages to date have been devoted to environmental themes, such as the promotion of renewable forms of energy and energy efficiency, sustainable forms of transportation and water and waste management. In order to achieve the desired economic effect of any fiscal stimulus, including a green one, swift implementation is required. Ensuring that such implementation is not at the expense of transparency, accountability and effectiveness demands both flexibility and creativity.

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[61] World Trade Organization news release, "Lamy warns trade finance situation 'Deteriorating'", 12 November 2008 (www.wto.org/english/news_e/news08/e/gc_dg_stat_12nov08_e.htm).

[62] World Bank, *Global Economic Prospects: Commodities at the Crossroads*, Washington, D.C., World Bank, 2008.

112. Further efforts are required to reorient and refocus development assistance towards the achievement of the Millennium Development Goals and the commitments of the Rio and Johannesburg Summits.[7]

113. Growing evidence from economic research shows that opportunities exist to reorient public spending and private investment in sectors that can lead to sustainable economic growth and development, create new employment and contribute to reducing carbon dependency and ecological scarcity. Bilateral and multilateral aid donors should increase their development assistance over the next few years and target it at the sectors and actions that would promote a transition towards a green economy.

114. In addition, the international community should consider developing and expanding innovative financing mechanisms, such as the International Finance Facility, the Climate Investment Funds and Global Clean Energy, Inc., as possible means to contribute to meeting global funding requirements.

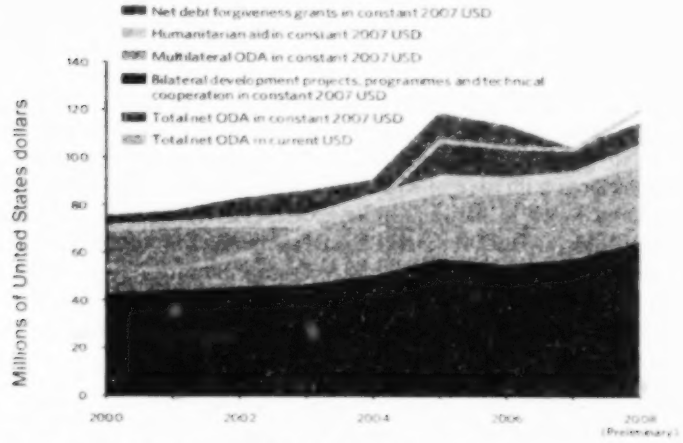
115. At the domestic level, a range of domestic policy interventions are needed to ensure that harmful policies and subsidies are reformed in order to focus investment and financing in areas that advance the objectives of sustainable development.

116. Following a decline in 2006 and 2007, official development assistance (ODA) from members of the Development Assistance Committee of the Organization for Economic Cooperation and Development (OECD/DAC) rose to $119.8 billion in 2008, an increase of 10 per cent in real terms over that of 2007.[63]

117. Although the share of ODA in the gross national income (GNI) of developed countries rose from 0.28 per cent in 2007 to 0.30 per cent in 2008, it remained below the 0.33 per cent reached in 2005 (see figures XXIX and XXX). Although ODA reached its highest level ever in 2008, large delivery gaps remain in meeting existing commitments. The 2010 Gleneagles target is approximately $154 billion at current values; additional flows of $17 billion a year would be required to achieve that ODA target. Aid to Africa reached about $26 billion in 2008, but is still about $20 billion short of being on track. In 2007, ODA to the least developed countries was equivalent to 0.09 per cent of the gross national income of OECD countries. However, less than half the OECD/DAC countries are meeting the 0.15-0.20 per cent target for aid to the least developed countries that was reaffirmed as part of the Programme of Action for the Least Developed Countries for the 1990s which had been adopted in Brussels in 2001.[63]

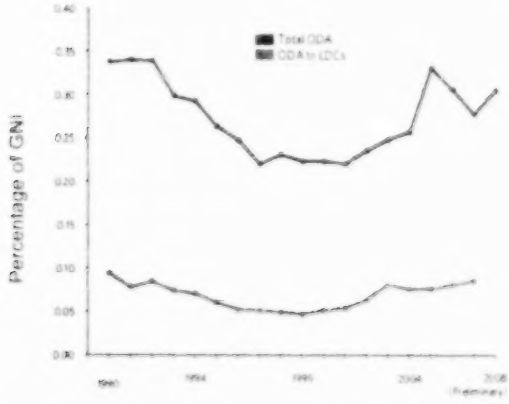
[63] Organization for Economic Cooperation and Development (OECD) Development Cooperation Directorate, "Development aid at its highest level ever in 2008" (www.oecd.org/document/35/0,3343,en_2649_34447_42458595_1_1_1_1,00.html).

Figure XXIX
Official development assistance from developed countries, 2000-2008



Source: Millennium Development Goals Report 2009.

Figure XXX
Net official development assistance from OECD-DAC countries as a proportion of donors' GNI, 1990-2008



Source: Millennium Development Goals Report 2009.

118. The distribution of ODA across countries is skewed; on several counts, it does not favour countries with the least means and largest numbers of poor people. By region, sub-Saharan Africa continues to be the largest recipient of ODA, having more than doubled the receipts in current dollars between 2000 and 2007. Western Asia ranks second owing to the large increase in funding for humanitarian and reconstruction purposes in Iraq. ODA flows to South-Central Asia also more than doubled over the seven-year period, largely because of the increase in assistance to Afghanistan; however, the flows remain small relative to the number of extremely poor people in that part of Asia. International assistance to South-Eastern Asia

declined during the period, even though poverty rates remain moderately high. An increase in the number of development partners, including those involved in new multilateral arrangements and South-South cooperation in addition to a range of non-governmental organizations, has contributed to the increase in assistance received by the developing countries since the adoption of the United Nations Millennium Declaration in 2000 (see General Assembly resolution 55/2).

119. An increase in the number of development partners and amount of aid has also compounded the challenge faced by recipient countries in managing development assistance. In order to maximize the benefits of international support, developing countries and their partners will have to reduce the fragmentation of this assistance and ensure that it contributes to national development strategies. The 2005 Paris Declaration on Aid Effectiveness and the 2008 Accra Agenda for Action[64] set out a number of principles and practices to guide developing countries in establishing their own strategies and partners in aligning themselves with those strategies and harmonizing actions among themselves.

120. However, ODA is not enough to achieve the internationally agreed development goals of developing countries. A genuine partnership between developed and developing countries is needed in order that the concerns of recipient countries could be met, as well as those of development partners. The development community has little choice but to continue to explore new sources of financing, innovative private-to-private sector solutions and public-private partnerships in order to mobilize additional international financing.

121. In one of the largest expansions of private capital flows to developing countries in recent decades, private medium and long-term capital flows more than tripled in size from $195 billion in 2000 to $670 billion in 2006. This period also saw significant diversification in the composition of private flows to developing countries, that is, for foreign direct investment, portfolio bond and equity flows, bank lending and derivative instruments[65] (see box 21).

Box 21
New sources of financing for Africa

Official aid alone will not be adequate for funding efforts to accelerate economic growth and poverty alleviation and other Millennium Development Goals in Africa, even though official development assistance is the largest source of aid for Africa. Sub-Saharan African countries need to make external finance more broad-based, attract a broader category of investors, such as pension funds and institutional investors, and expand public-private partnerships in order to raise additional external financing. Donors and international financial institutions can play an important role by furnishing guarantees, political risk insurance, help in establishing ratings and supplying advice on financial instruments, such as the securitization of remittances and

[64] A/63/539, annex.

[65] Dilip Ratha, Sanket Mohapatra and Sonia Plaza, *Beyond Aid: New Sources and Innovative Mechanisms for Financing Development in Sub-Saharan Africa*, Policy Working Paper 4609, Washington, D.C., World Bank, April 2008.

other future-flow receivables. Accessing private capital markets in a responsible manner will require a sound contractual environment, as well as credible monetary, fiscal and exchange rate policies, but ultimately the private sector will need to be the engine of growth and employment-generation. Official aid efforts must catalyse innovative financing solutions for the private sector. New sources include diaspora bonds, which are a debt instrument issued by a country, or potentially by a sub-sovereign entity, or by a private corporation, in order to raise financing from its overseas diaspora population. The stock of sub-Saharan African diaspora members is estimated to be about 16 million, with 5 million in high-income countries. Reducing remittance costs would increase remittance flows to sub-Saharan Africa, as it is believed that sub-Saharan Africa has the highest share of remittances flowing through informal channels among all regions of the world. Other innovative ways of using existing resources include recovery of flight capital and stolen assets. The cross-border flow of the global proceeds from criminal activity, corruption, and tax evasion are estimated to be more than $1 trillion annually.

Source: World Bank.

C. Technology transfer and knowledge-sharing

122. It is not clear yet how the financial and economic crisis will influence the transfer of technology, but the need for access to new technologies is widening, especially with the recognition that urgent action will have to be undertaken in order to address the challenge of climate change. As early as 1972, the United Nations Conference on the Human Environment[66] had included explicit language emphasizing the importance of technology transfer for the achievement of environmental and developmental goals. Ever since then, the transfer of technology and knowledge-sharing have been essential components in the process of achieving sustainable development.

123. Existing best-practice technologies for a low-emissions economy are already in place in advanced economies and further breakthroughs are likely. Technology transfer is therefore a critical international public policy issue. At the same time, developing countries will need support in building their own technological capacity in order to ensure that they undergo a smooth transition to a low-emissions economy and maintain competitiveness in an open global economy.

124. In order for developing countries to be able to deal with these challenges multiplied by climate change factors, it is necessary to focus on a climate technology programme that could possibly be established under the auspices of the Conference of the Parties to the United Nations Framework Convention on Climate Change.[67] Such a programme would (a) examine the various dimensions of the technology challenge in developing countries and, where appropriate, furnish

[66] See *Report of the United Nations Conference on the Human Environment, Stockholm, 5-16 June 1972* (A/CONF.48/14/Rev.1), part one, chap. I.

[67] See FCCC/CP/2005/5.

technical assistance with respect to greening the economy; (b) establish a global research, development and deployment fund which would monitor technology development; and (c) foster a balanced intellectual property regime for technology transfer.[68]

125. Knowledge-sharing, especially in today's globalized world with developed information and communication technologies, is very important for supporting sustainable development, especially in developing countries (see box 22).

126. The scientific community has done much in establishing institutions, in making professional assessment available to the general public, in developing tools for analysis (environmental impact assessment, indicators, vulnerability analysis, risk assessment, hotspots analysis, scenario analysis and valuation techniques), as well as in propagating the integrated planning and management of water, land use and energy. The scientific basis for decision-making related to sustainable development has been strengthened by the establishment of a number of institutes and "think tanks" all over the world. Another innovation from the scientific community concerns the professional assessment of the policy literature. An example is the Intergovernmental Panel on Climate Change.

Box 22
Sustainable development knowledge partnership

A noteworthy outcome of the Commission on Sustainable Development at its seventeenth session was the formation of a "sustainable development knowledge partnership" aimed at mobilizing intellectual resources in support of global and national policies and actions on sustainable development.

D. Capacity-building

127. In order to strengthen capacity-building, greater national capacities are necessary for designing national plans together with a wider involvement of non-State actors, a deeper understanding in the international community of capacity-development issues, more focus on the demands of users, improved aid coordination and donor collaboration, more capacity investments on the regional and global levels and a greater role for information technology in capacity-building.

128. Improvement has been made in this area at all levels, especially in involving non-State actors. It has been recognized that more attention is now being given to the enabling environment or the broader context of capacity-building programmes (political, social, cultural, legal and institutional) and the ways in which key stakeholders can support or prevent progress. More emphasis is being placed on the role of users and beneficiaries. Donors are becoming more supportive and facilitative (see box 23).

[68] *World Economic and Social Survey 2009: Promoting Development, Saving the Planet* (United Nations publication, Sales No. E.09.II.C.1).

Box 23
Capacity-building in Africa

The African Capacity Building Foundation, based in Harare, is an independent, capacity-building institution established in 1991 through the collaborative efforts of three multilateral institutions, namely the African Development Bank, the World Bank and the United Nations Development Programme, as well as African Governments and bilateral donors. Its objectives are to build and strengthen sustainable human and institutional capacity in the core public sector, in the sector's interface areas with the private sector and civil society, in training and research institutions, as well as within regional organizations, in order to spur economic growth, poverty reduction, good governance and effective participation by Africa in the global economy. The projects and programmes are classified into core public sector interventions, interface operations, support for regional institutions and a special intervention. The core public sector projects and programmes consist of interventions in economic policy analysis and management, economic and financial management training, financial management and accountability, public administration and management and policy analysis capacity of national parliaments. The interface operations comprise national economic consultative councils for tripartite negotiations, networks of non-governmental organizations for dialogue and policy advocacy, public-private sector interface, support for corporate governance in the private sector and projects to reform the public sector to enable it to support the emergence of a growth-oriented private sector. At the regional level, the portfolio comprises additional operations in support of regional organizations.

Note: More about the African Capacity Building Foundation may be found at www.acbf-pact.org.

IX. Continuing challenges

129. Limited success has been achieved in bridging the gulf between different agendas regarding sustainable development. There are indications of intellectual and policy development that can help to usher in the next phase in this evolution, where the core idea of sustainable development can come into its own. The core idea is not only to integrate and combine the environment and development in a "synergistic manner, but also to mainstream effectively sustainability considerations into economic and developmental decision-making and to ensure that all development actions are approached through the prism of sustainability. In return, the environment and what represents "natural capital" could act as an important driver for future economic prosperity. If sufficient resources could be invested in a greening of economies, this would not only contribute to sustainable economic growth, but also generate significant employment and reduce poverty, while lowering carbon dependency and resource scarcity.

130. The analysis suggests that the momentum towards an unsustainable future could be reversed, but only with great difficulty. It assumes fundamental shifts in desired lifestyles, values and technology. Yet, even under these assumptions, it would take many decades to realign human activity with a healthy environment, make poverty obsolete and ameliorate the deep fissures that divide people. Some climate change is irrevocable; water stress will persist in many places, extinct species will not return and lives will be lost to deprivation. Nevertheless, a planetary transition towards a humane, just and balanced ecological future is possible. However, the curve of development must be bent twice: radical revision of the technological means to begin the transition, and a reconsideration of human goals to complete it. This is the promise and the lure of the global future.